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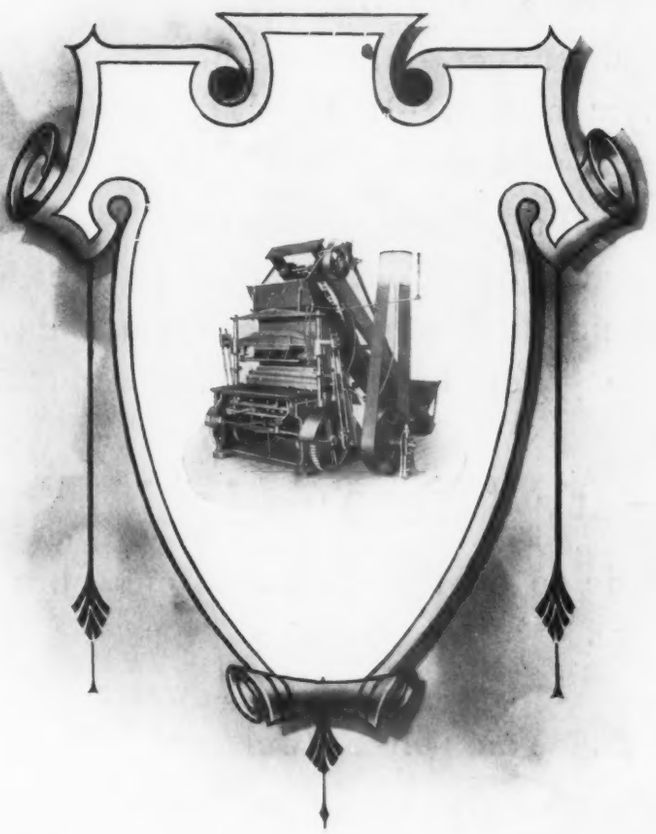

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The Question of the Day.

WET or DRY?

If **Dry** — It's "Kantbebeat" Dry Core Compound.

One fellow says,—"It's alright."
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And one of our most prominent foundrymen says, "It saved me many hundreds of dollars in the cleaning room."

Be of the same opinion by ordering a quantity of "Kantbebeat" Dry Core Compound suitable for large, medium, and small castings, and brass and malleable foundries.

If **Wet** — It's "Esso" Liquid Core Binder.

Made to do the work—no guess, but it's there.

Used instead of Molasses water or clay wash. You will be well satisfied.

Will go twice as far as Molasses.

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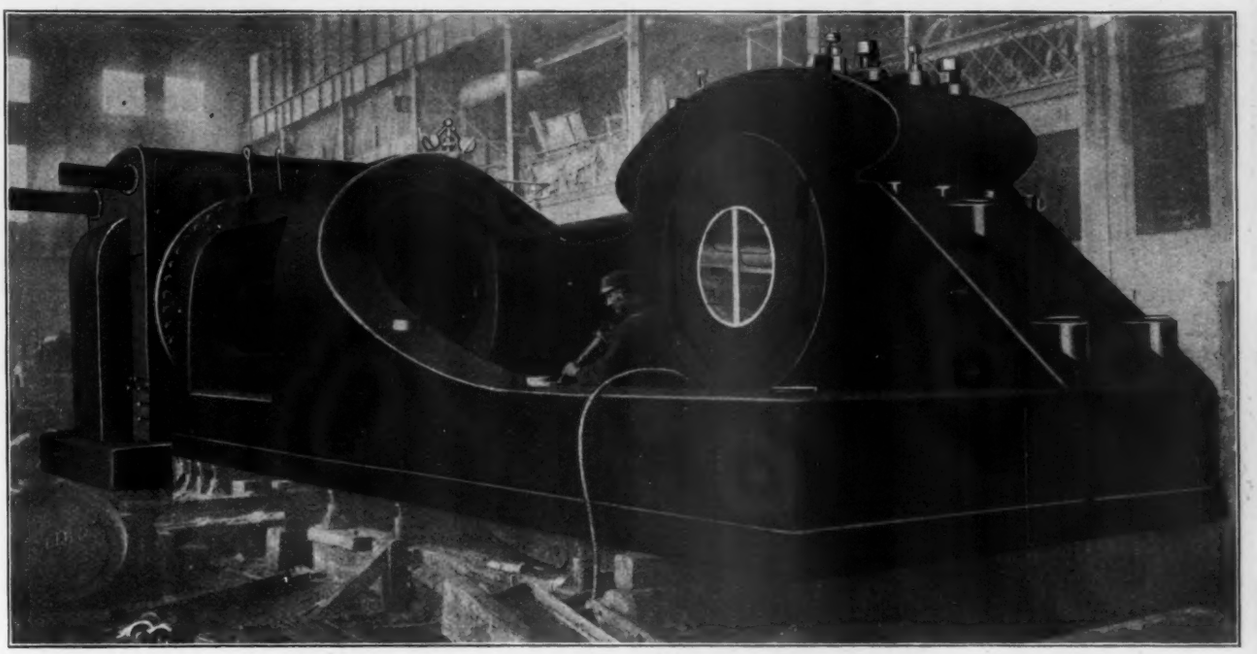

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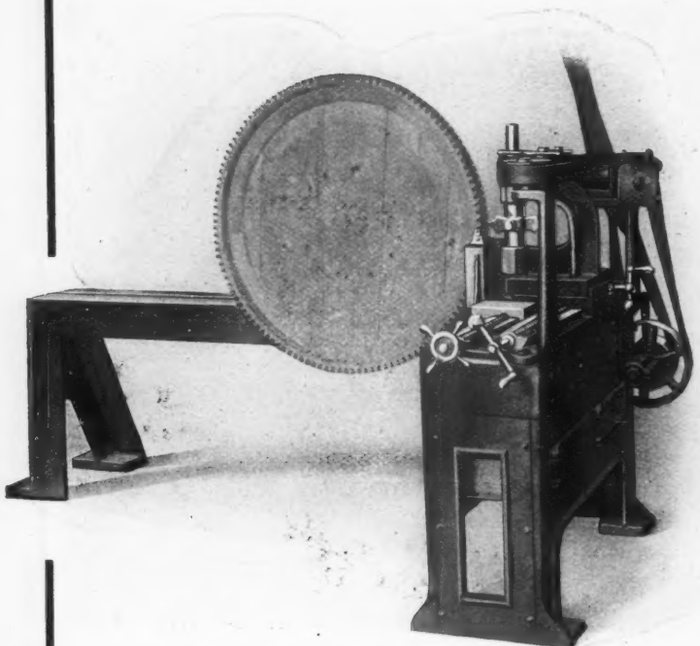

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Cut Gears taken from machine are ready for shellac without any Sand papering. Let your local pattern-maker figure on your gears and then deduct 75% and you have a liberal price of what gears will cost you cut on this machine. Gears made on this machine are absolutely perfect.

Write for samples of gear teeth, and full description of machine, with price.

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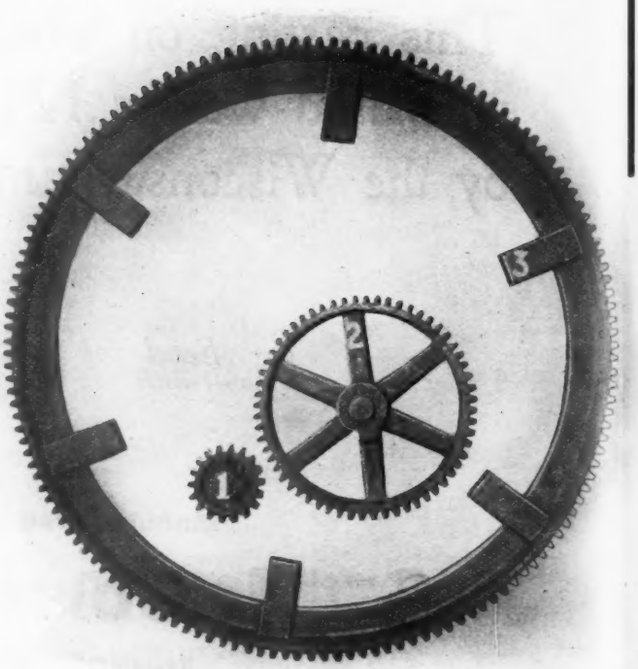

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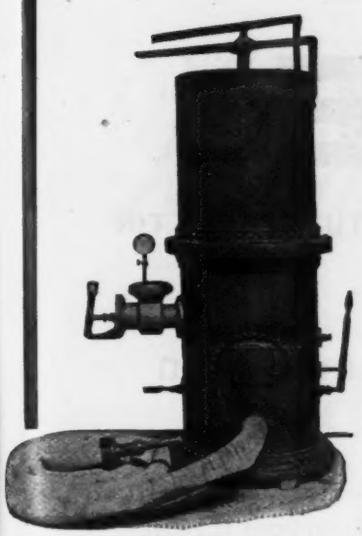

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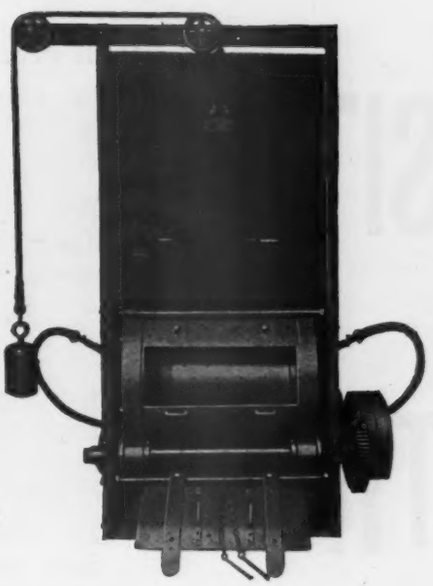

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I. Will save from 40 to 45 % on your tin bill.

II. Will save from 10 to 30 % in finishing your castings.

III. Will practically eliminate porosity in your castings.

IV. Makes a much denser and tougher casting than tin, and is practically non-crystallizable.

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I. Containing Bassite can be finished at from 65 to 80 % the cost of castings containing tin, because they will take the tool freely, cutting very easily.

II. Containing Bassite will take a much finer polish than any other brass casting.

This product is especially adapted to Steam Goods, Machinery and Automobile Brass Castings.

Let us give you proof of the above assertions, and ship you a trial order of 100 pounds.

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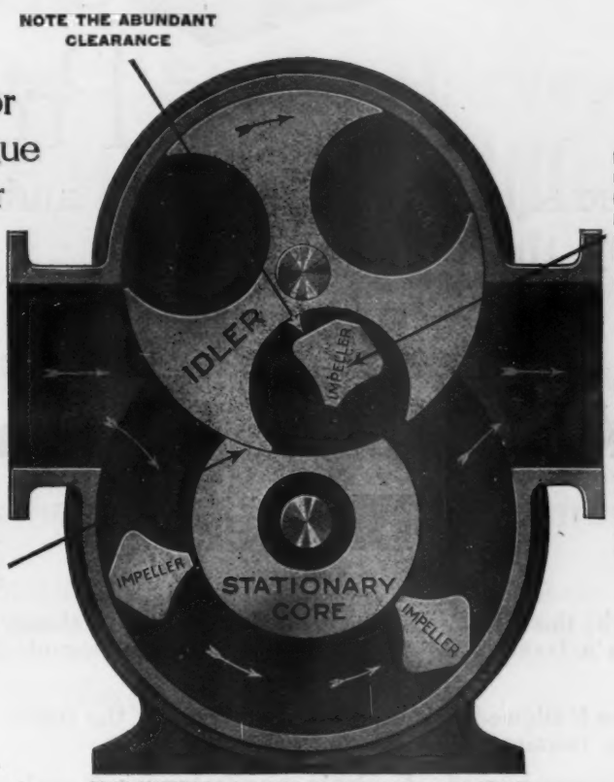
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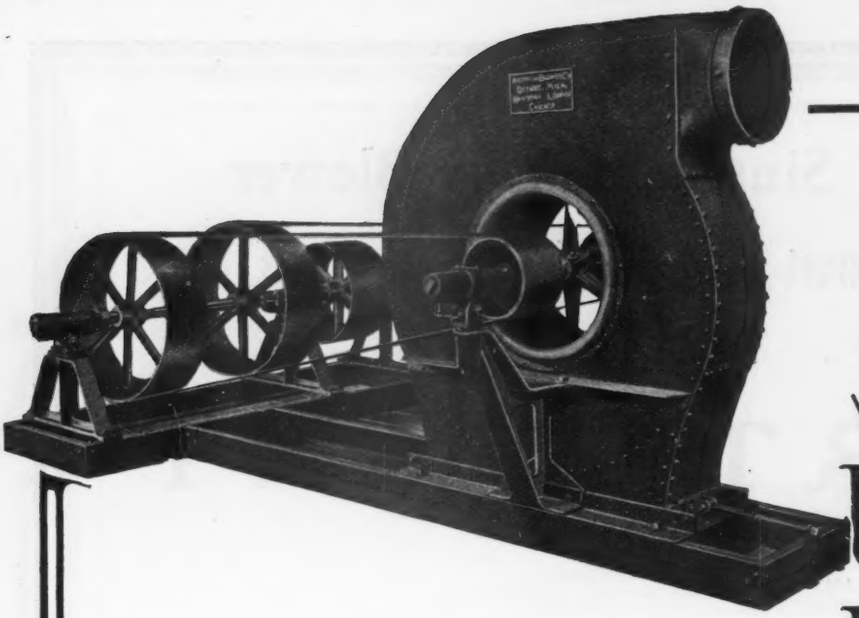

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Altogether, it is a much more desirable apparatus, as it costs less in the first place, is less expensive to operate, easier to manage, more durable and gives better results.

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The "Steele-Harvey"
CRUCIBLE TILTING MELTING FURNACE
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All kinds of "Miscellaneous Furnaces."

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Capacities from 30 to 1500 lbs. per heat.

Will contract to equip with necessary number of furnaces, prices accordingly, Immediate Shipment, and guarantee satisfactory terms of settlement, all upon basis of "approval after demonstration."

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If everybody would sing like you there would be no "Hard Times."

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Then why not sing? Remember dear old Mark Tapley?

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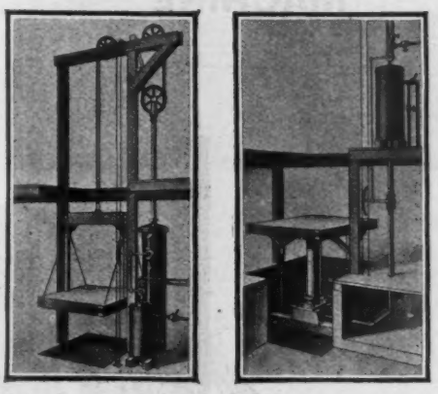
We are "coming out strong." We are hustling as never before in our lives for elevators and cranes.

We are naming prices that tempt folks to buy elevators and fix up the sorest spot about most foundries.



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No, we are not cutting wages either. Our boys know we are doing all we can to keep them employed and so they are doing all they can to make elevators quickly and make them good.

Wages are only a comparative matter after all. Some men are cheap at 5 dollars a day and others are dear at 2 dollars. It all depends upon the man.

When you cut wages and belliake you do more to make "Hard Times" than any other man on earth. Smile, fix up your elevators and

Hook'er to the Biler

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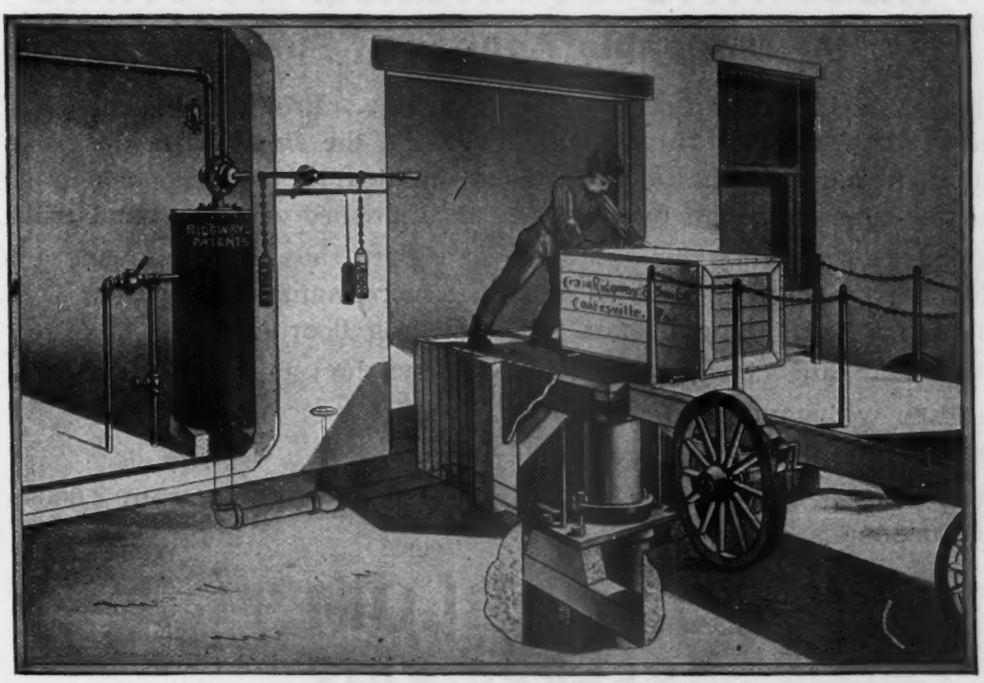

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ONE MAN AND ONE CHARGING MACHINE

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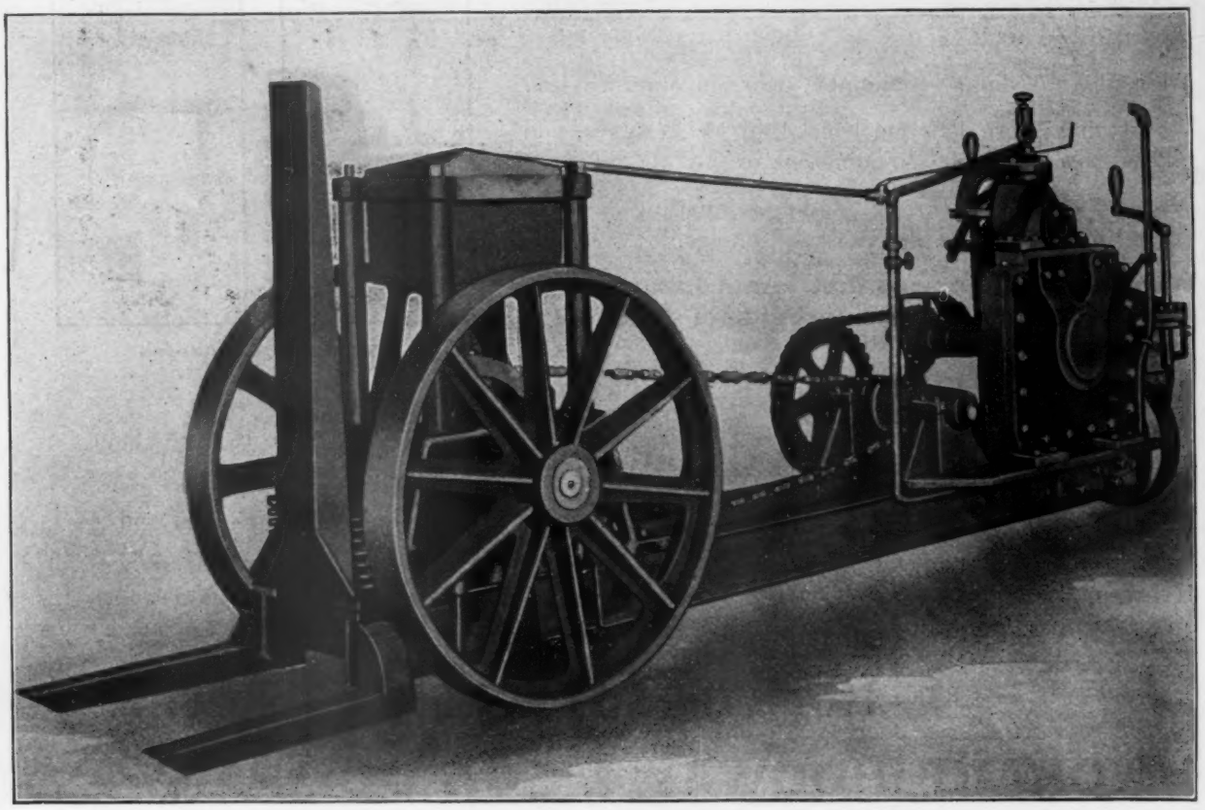

PNEUMATIC CHARGING MACHINE

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This is the greatest labor saving machine introduced in malleable foundries in the last fifty years. Will do the work of no less than ten men and will charge and unload malleable furnaces in a much shorter time than can possibly be accomplished with the hand truck.

Foundries operating these machines report that one man and one machine do the same work and do it more satisfactorily than 12 to 18 men formerly engaged on the annealing floor.

The Pneumatic charger will earn **dollars** for you every day.

Built to withstand severe service.

Can be operated in any malleable plant.

Built in 3 sizes for stacks of charging boxes weighing from 2,000 to 10,000 pounds.

J. G. BLUM

TOLEDO, OHIO

THE FOUNDRY

Vol. 32, No. 3 CLEVELAND, OHIO, MAY, 1908 Whole No. 189

MACHINE-MOLDED STOVE PLATE

Latter-Day Development in the Art of Molding Stove Castings—Output Increased and Losses Reduced

NOTWITHSTANDING its adaptability for the economical molding of stove plate, the molding machine is only a recent innovation in the stove foundry. Tradition and sentiment were potent factors in retarding the introduction of machine molding in this important branch of the foundry industry, but the successes that have been recorded in a few plants, where this marked departure from archaic methods was ventured, foreshadows a rapid development in the art of molding stove plate by machine. For many years, efforts have been made to interest the stove plate founder in this labor-saving device, but he invariably contended that his castings were so thin in sections that they could only be produced by highly skilled molders. Besides, it was argued that no machine could be devised that could successfully "print-back" the patterns, an essential feature of stove plate work, owing to the artistic design of many of the castings.

Less than three years ago, a manufacturer, in discussing labor saving appliances in stove foundries, made the following statement: "Beginning at the foundation of all our profit, and incidentally much of our trouble—the foundry—we find the molding machine gives greatest promise, although not in any way entirely satisfactory as yet. To get best results, it should be installed with automatic sand tempering and riddling machinery, conveyors to deliver and remove the sand, and with methods of doing all

FIG. 1—PATTERN FOR TWO STOVE DOORS MOUNTED ON A ROCK-OVER MACHINE, THE COPE BEING MADE ON THE STAND

FIG. 2—METHOD OF MOLDING A HEATER TOP. THE DRAG IS MADE ON THE ROCK-OVER MACHINE AND THE COPE ON THE STRIPPING PLATE MACHINE

lifting and handling by power. Each of these individual problems has been fully worked out for classes of work other than stove plate, but as yet unconsolidated into a complete system to produce high grade castings. Some genius also has a large field before him in the production of a machine which will print-back faced work and obtain as good results as by hand."

From the results that have been achieved, not only in the successful molding of the most artistic patterns, but in the economical production of castings, it is evident that the genius referred to has solved the problem that confronted the stove founder, and all objections to the mounting of stove patterns on machines are gradually being overcome.

Molding Machine Equipment.

While the first molding machine was installed in the stove foundry of the estate of P. D. Beckwith, Inc., Dowagiac, Mich., less than a year ago, 55 are now in use. The entire equipment has been installed by Henry E. Pridmore, Chicago, manufacturer of molding machines, and consists of about 50 rock-over drop machines, four stripping plate machines, and one of the rock-over drop type. The rock-over machines are especially adapted to stove plate work, and as their name implies, the main feature of their operation consists of

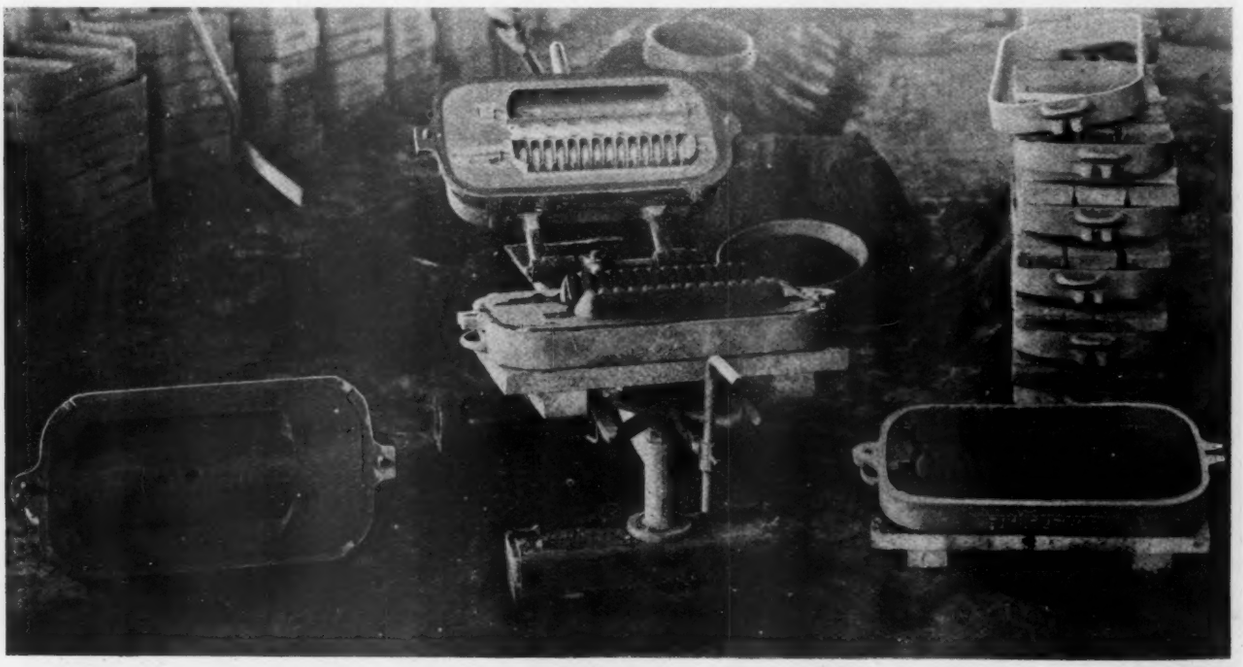


FIG. 3—THE DRAG OF THE MOLD CONTAINING TWO RANGE GRATES IS MADE ON THE ROCK-OVER MACHINE AND THE COPE IS MADE ON THE STAND

FIG. 4—TWO HEATER DOMES ON ONE PATTERN PLATE, THE DRAG BEING MADE ON THE ROCK-OVER MACHINE AND THE COPE ON THE STAND

rocking the pattern over after the mold has been rammed. The machine consists of a main frame with either single or double stands, depending upon the size of the pattern to be molded, a rock-over frame to which the pattern plate with the pattern mounted thereon is attached; a set of flask rests, which are automatically adjustable to crooked bottom boards and flasks; a flask rod used for clamping the bottom board and flask on to the rock-over frame while the mold is being rocked over, and a set of springs, which facilitate the operation of rocking over. Patterns can be fitted to these machines very quickly and at a low cost, as it is only a matter of attaching the pattern to a plate and then screwing the plate on to the rock-over frame. The plain rock-over machines differ from the rock-over drop type in that the patterns for which they are to be used must have sufficient draft to be rocked out without breaking the mold. Inasmuch as it is unnecessary to drop the flask away from the patterns, as in the case of the rock-over drop type, the plain rock-over machines can be operated somewhat more rapidly.

Molding Stove Doors.

The pattern for two stove doors, mounted on a rock-over machine is shown in Fig. 1. The drag is made on a machine, being rammed by hand and the cope is made on the

FIG. 5—THE DRAG PATTERN FOR A RANGE GRATE REST IS MOUNTED ON THE MOLDING MACHINE AND THE COPE IS MADE ON THE STAND

FIG. 6—A FOOT RAIL PATTERN IS SHOWN ON THE ONE MACHINE AND TWO ASH PIT DOORS ON THE OTHER

stand. The drag pattern was "printed-back" in the mold shown in the foreground, and that the artistic outline has been retained can readily be seen. The machine being portable can easily be moved along the sand heap as the day's work develops.

Machine Molded Heater Top.

Cope and drag patterns of a "Round Oak" heater top, mounted on stripping plate and rock-over machines, respectively, are shown in Fig. 2. Both cope and drag parts of the mold are shown in the foreground, the artistic face of the pattern having been retained in all its delicate outlines in the drag. The body of hanging sand in the cope is unusually large and the green sand core for the flue is carried in this part of the mold.

Molding Range Grates.

Two range grates are shown on a rock-over machine in Fig. 3, the cope being made on the stand. Two heater domes are shown mounted on a rock-over machine in Fig. 4. The cope is made on the stand, the hanging body of sand being considerable. The faces of the castings are artistic in design and the patterns for the drag mold are printed-back. The gates in the cope can be plainly seen and are less than ⅛-inch wide.

The rock-over machine, equipped with the pattern for a range grate rest, is shown in Fig. 5. Three dry sand cores are set in the drag as shown, the cope being made on the stand.

A foot rail pattern mounted on a rock-over machine is shown in Fig. 6, the cope and drag being shown at the

FIG. 7—VIEW OF ONE OF THE FIRE POT MOLDING FLOORS

FIG. 8—METHOD OF MOLDING A GRATE REST FROM A PATTERN PLATE, CAST IRON HINGED FLASKS BEING USED

left of this illustration. At the right are shown two ash pit doors made in one mold.

Special Flask Equipment.

The special flask equipment shown in Figs. 1 to 6 is an essential feature that has contributed to some extent to the success of the molding machine practice in this plant. All of the flasks are cast iron and are designed to carefully conform to the outlines of the pattern, and, in addition, the amount of sand in each mold is reduced to the minimum. All of the patterns are likewise made of cast iron. While the first cost of this equipment has been large, nevertheless, the resultant economies have more than justified these expenditures. As compared with previous practice, the number of molds made daily on each floor has been more than doubled, and, in addition, the losses have been greatly reduced.

"Round Oak" Stove Foundries.

In 1870, the first "Round Oak" heater was manufactured by the firm which is now known as the Estate of P. D. Beckwith, Inc. The "Round Oak" line was extended from year to year until it now includes, in addition to the seven sizes of heaters, three sizes of ranges, six sizes of furnaces, three sizes of base heaters and four sizes of air-tight stoves. The daily output of castings, which now averages 80 to 100 tons, is indicative of the growth of business, which was started in a very small way 40 years ago. The castings for the plant are made in two foundries, one 240 feet square and the other 300 x 100 feet. The metal is melted in three cupolas,

FIG. 9—MOLD FOR A HEATER BOTTOM CASTING. THE SPRUES ARE SHOWN ON THE HINGES IN THE FOREGROUND

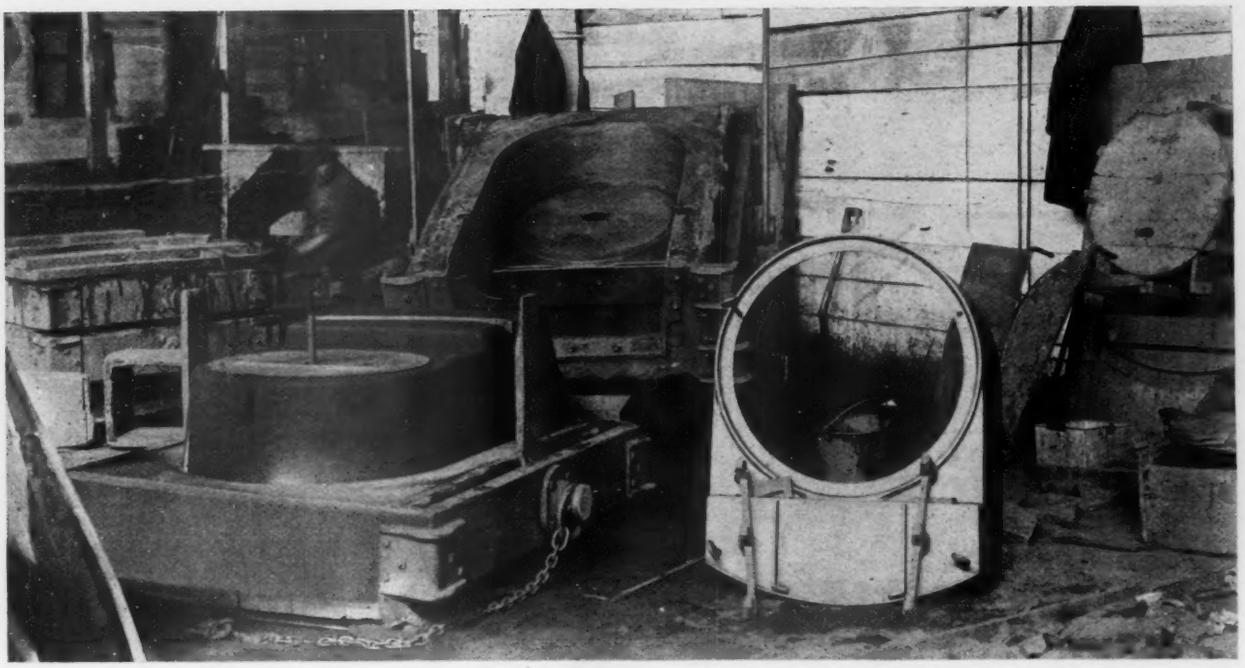


FIG. 10—MOLD AND PATTERN OF A SINGLE-PIECE, AIR-TIGHT FURNACE BOTTOM

each 72 inches in diameter inside the shell.

Labor-Saving Equipment.

Modern stove foundry practice is reflected by the labor-saving equipment installed in both plants. With only a few exceptions, cast iron flasks are used throughout and all wooden flasks are hinged, thereby not only reducing the manual labor of molding, but greatly increasing the daily output. All patterns, whether used on the floor, mounted on machines, or used for snap flask work, are made of cast iron. The number of castings entering into the construction of a stove are much larger than generally supposed, and frequently no less than 60 patterns are required to complete the set for only one size. This is indicative of the enormous expense incurred in the installation of the special flask equipment alone. Yet, this cost is insignificant when compared with the saving of sand, not considering other economies thereby effected.

Fig. 7 shows a view of a floor on which fire pots are molded exclusively. The three-part flasks are of cast iron construction and the method of clamping and the adjustment of the pins are all designed to facilitate the molding operations.

Molding a Grate Rest.

The hinged cast iron flasks shown in Fig. 8 are used to a large extent throughout the plant. Cast iron pattern plates are used, the drag side of the pattern being shown at the left of the illustration and the cope at the right. The pattern plates are

FIG. 11—MOLDING A FURNACE TOP MADE IN ONE PIECE. THE PATTERN IS IN NINE PARTS

FIG. 12—FLASK CONTAINING THE MOLD OF A SINGLE-PIECE, HORSESHOE FURNACE RADIATOR. THIS SHOWS THE METHOD OF CLAMPING AND HOLDING DOWN THE LARGE CORE

grooved to fit the flask pins, which insures rapid and accurate adjustment. The pattern shown is that of a grate rest. When making the mold the drag is rammed up first, rolled over and the cope is made. The flask is then opened, the pattern plate removed, the flask closed and the mold is completed.

Method of Molding a Heater Bottom.

The mold for a heater bottom casting containing the ash pan is shown in Fig. 9. The pattern is in two parts, the ash pan being in the drag section. The cope is rammed up first with the whole pattern in place. It is than rolled over and the core is rammed. The drag is then rammed up, the flask opened and the face part of the pattern is drawn out of the sand. The mold is then clamped, rolled over, opened and the ash pan pattern is withdrawn. The mold is then closed again and clamped and is made ready for the metal. The flasks are hinged, as shown, and the two tapering sprues on the hinges, which make the two gates for the mold, are ⅛ of an inch wide at the small end.

Special cast iron flasks for large fire pots are shown in Fig. 13. The metal enters the mold from the bottom, provision being made for the runner outside of the flask proper, the runner jacket being made of cast iron securely bolted to the flask.

Furnace Castings.

When the company decided to build furnaces, the problem of making large

FIG. 13—A PAIR OF SPECIAL FLASKS FOR LARGE FIRE POTS

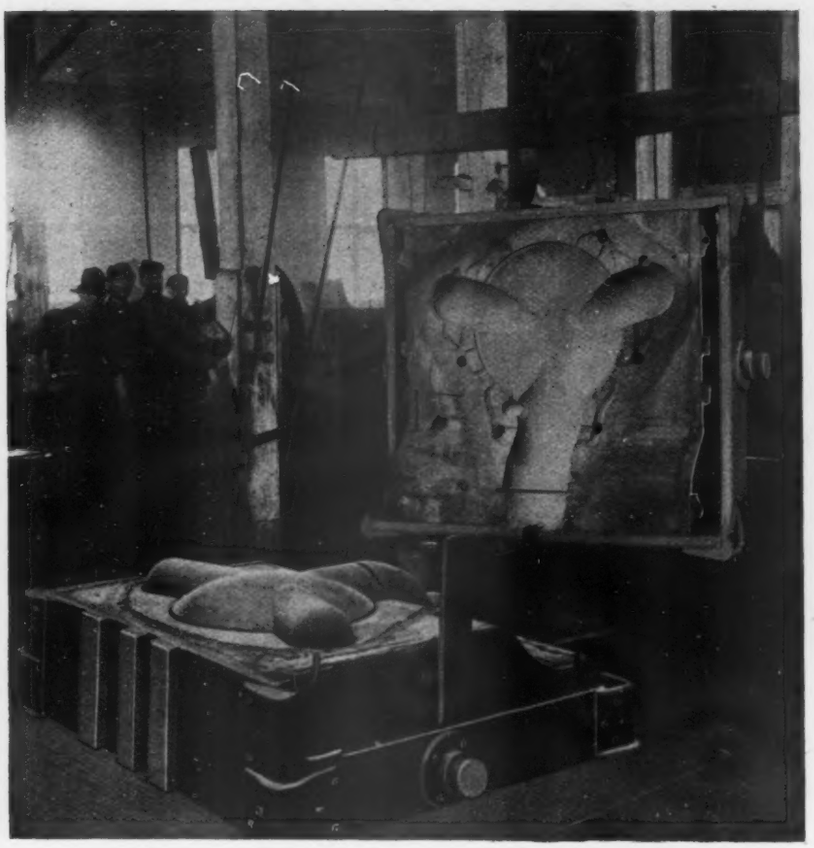


FIG. 14—FINISHED MOLD OF AN AIR-TIGHT FURNACE TOP. COPE IS SUSPENDED

castings of comparatively thin section was presented. It was concluded to make the equipment as permanent as possible and to install labor-saving appliances to expedite the molding operations. All patterns were made of cast iron, and air hoists and jib cranes were provided for handling flasks and rolling over the molds. The flasks were also especially designed and constructed to conform to the shape of the patterns and the molding cost has consequently been greatly reduced.

The mold and pattern of a single-piece air-tight furnace bottom are shown in Fig. 10. The drag half of the mold is shown suspended from the crane and the cope is in the foreground, carrying the core, which is subsequently in the drag when the mold has been rolled over. The construction of the flask, reinforced at the corners with cast iron angle plates, can readily be seen.

Furnace Top Castings.

Molds for furnace tops, which are cast in one piece, making them absolutely air tight, are shown in Figs. 11 and 14. These patterns are in nine parts, and, as shown in Fig. 14, the metal enters the mold at six points. This illustration shows the cope and drag finished, and the mold ready for closing and clamping. In Fig. 11 a part of a pattern is still shown in the cope.

Molding a Furnace Radiator.

The flask containing the mold of a single-piece, horseshoe furnace radiator is shown in Fig. 12, and the mold just before closing is shown in Fig. 15. The cast iron pattern for this casting is in two parts, the cope being rammed up first, then the core, and one-half of the pattern is next drawn out of the sand. The mold is then rolled over, the drag is rammed up, the mold rolled over again, and the cope is lifted off. The core, which is unusually large, contains an arbor with prickers cast on, which is supported at five points. The core is held down by nine chaplets, which can clearly be seen in Fig. 15. While the cope is suspended and when the mold is being closed, the chaplets are clamped from the outside. The chaplets, when the mold is closed, have a metal-to-metal bearing on nine projections from the core arbor. The method of clamping the mold and securing the chaplets is shown in Fig. 12. Steel bars, with threaded bolts recessed at their ends to fit the points of the chaplets, are laid across the mold and clamped, as shown. The bolts are well screwed down to hold the chaplets in place. This is one of the

FIG. 15—FINISHED MOLD OF A SINGLE-PIECE, HORSESHOE FURNACE RADIATOR

most important operations connected with the making of the mold. The eight sprues are also shown in position, the mold being poured with metal from eight hand ladles.

Distribution of Metal.

To facilitate the distribution of metal, overhead trolleys have been installed, which lead from the cupolas to all the molding floors. The method of suspending the hand ladles from the overhead track is shown in Fig. 16. The cast iron ladle rests in a circular steel cradle on the bottom of the trolley and the molder guides the trolley to his floor with a shank of the ladle. A large part of the enervating manual labor when pouring off has been eliminated by the installation of this overhead track, and the metal can be distributed to the floors more speedily and at a higher temperature than formerly when the molders were compelled to carry the metal to their floors.

Fig. 17 shows the simple device used for removing the cupola drop. The bottom is dropped on to the cradle shown, and is removed from underneath the furnace on the cradle by a hand-operated windlass. This illustration also shows the reservoir ladle supports swung out to permit of the removal of the cupola bottom.

FIG. 16—OVERHEAD TRACK AND TROLLEY TO FACILITATE THE DISTRIBUTION OF METAL

Pneumatic Multiple Molding Machine.

A pneumatic multiple molding machine, of which a number are in use, designed and built by A. K. Beckwith, manager of the plant, is shown in Fig. 18. Two pattern plates are used, one above and one below, which make the drag and cope, respectively, in one operation. Molds of fire pot linings are shown, four in a flask, which are stacked nine high, making eight complete molds or 32 lining castings in one stack.

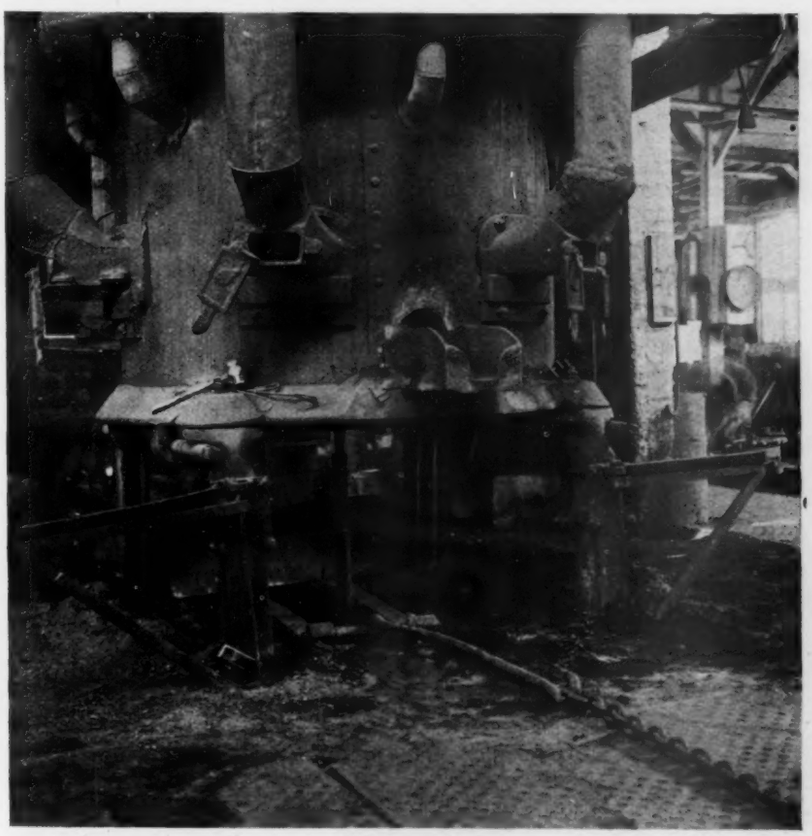


FIG. 17—SIMPLE DEVICE FOR REMOVING THE CUPOLA DROP

Shaking Out Stacked Molds.

The method of shaking out these molds is shown in Fig. 19. The stacks are elevated on an air hoist and a bar is inserted underneath the hoist with its opposite end pressing against the sprue. When the stack is elevated, the flasks are stripped free of the sand and the castings. The work of shaking out is thereby greatly expedited and the manual labor is almost entirely eliminated.

BRITISH FOUNDRYMEN'S ASSOCIATION.

A meeting of the Birmingham branch of the British Foundrymen's Association was held at the Technical School, Birmingham, on March 28. A paper was read by A. Fraser, entitled "Notes on Contraction."

The chairman, in opening the proceedings, congratulated the vice president of the national association, F. J. Cook, in

FIG. 18—ONE OF THE PNEUMATIC MULTIPLE MOLDING MACHINES FOR MOLDING FIRE POT LININGS

having obtained the diploma of the Society of Mechanical Engineers for the best paper of the season.

Mr. Fraser then read his paper, the subject of which he said might with equal accuracy have been given as "Equal Cooling." He had dealt with light castings more especially, because they showed more plainly and definitely the strains produced by unequal cooling. Most of them had experienced dismay on finding a casting made from an expensive and apparently perfect pattern either broken, bent or twisted, and the frequency with which that happened showed that that phase of foundry work was far from being an exact science.

After describing various difficulties, the speaker said it was not always practical to add weight or to take it out of parts of a pattern. With regard to bent patterns the method usually employed was to make a trial casting of white metal, test the bending and then bend or camber the pattern to about the same distance in the opposite direction, when the unequal cooling should bring it straight. Some faults such as twists or breaks could be altered by changing the position of the runners, but this could only be done where the inequality of cooling was not great.

The speaker dealt at some length with the varieties in bending of heavy and light castings. His explanation of the greater contraction of the light casting was in its possession of a higher combined carbon content. He then proceeded to describe a number of experiments such as changing the position of the runners, cooling more rapidly at the top than the bottom, and vice versa. In regard to flanges, he found that light flanges on light castings invariably bent, pulling the casting in the neighborhood of the flanges in their own direction. He showed how the process of cooling involved crushing and stress in various directions. Very important results accrued from the greater chilling effect and the more rapid loss of heat through the top than the bottom of the mold, but in some cases the escape of heat was greater through the bottom. The speaker laid stress upon the importance of the molder maintaining constant the conditions under which trials were made. He believed that the bending properties conformed to certain laws, but whether the knowledge of this would ever be sufficiently complete to insure precise working was a matter of doubt. Other experiments related to baring of castings. It is important to determine the exact heat at which the baring is done because if it is bared too early it will cool too quickly.

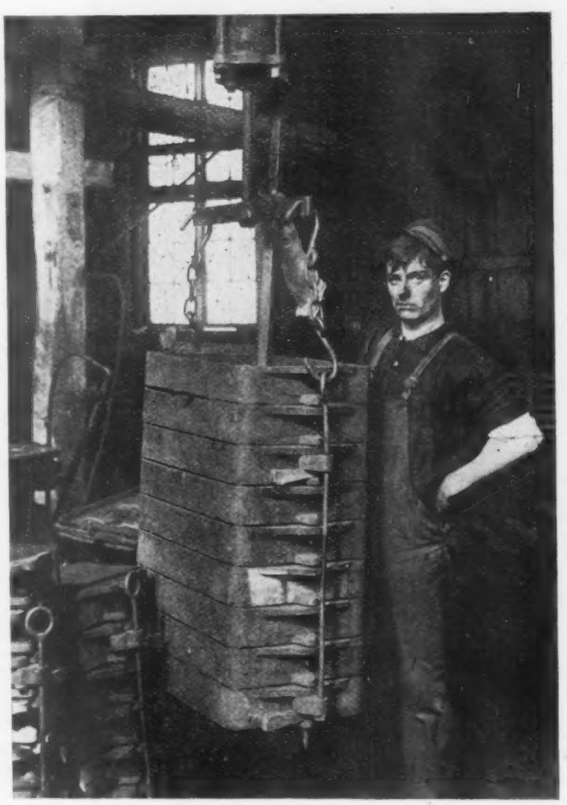


FIG. 19—METHOD OF SHAKING OUT STACKED MOLDS

PRODUCTION OF MALLEABLE CASTINGS-IV

A Discussion of Malleable Mixtures and the Materials Required Including Pig Iron and Various Classes of Scrap

BY RICHARD MOLDENKE

THE proper mixing of the irons going into a charge for malleable castings is of course the foundation of the whole subsequent work. With a mixture properly made, it then becomes a question of regularity in melting and annealing. It is a well known fact, that with everything in this direction running properly, a malleable mixture can stand some additions of odd gray iron scrap, steel shafting, old files, etc., and not run "off." When, however, the mixture is just on the line between good and bad, it takes the most careful nursing to recover normal conditions. This is due to the large proportion of sprues and scrap hard castings that must be cared for, and which carry to each successive heat all the bad characteristics of previous melts which may have been damaged. Before the science of mixing was understood, it was customary to remove every piece of hard scrap from the foundry, when trouble occurred, and to begin all over with a heat of all No. 2 pig irons. This was pigged and then used in place of the sprues for the mixture in the regular way. After a few heats, the old troublesome sprues were then fed in very carefully, or else used for making annealing boxes by running them through the cupola.

Necessary Materials.

It is first necessary to discuss the various materials entering into the mixture. These include pig iron, sprues and discards, annealed scrap made by the establishment, annealed scrap bought or taken in trade, steel scrap, wrought iron scrap, borings, cast iron scrap, and the ferro-alloys.

As all these materials have their bearing on the finished casting, and should be used only as they affect this, it will be desirable to give the composition of good malleable castings at this time. This is as follows:

	Per cent.
Silicon	from 0.45 to 1.00
Manganese	up to 0.30
Phosphorus	up to 0.225
Sulphur	up to 0.07
Total carbon	above 2.75 (in the hard)

This is normal malleable for American practice. In special cases, especially for very small castings, the silicon may go up as high as 1.25 per cent, while for very heavy work it may drop down to 0.35 per cent with very good results. In the case of charcoal iron this figure gives the strongest castings. With coke irons, however, especially when steel scrap additions are the rule, 0.45 should be the lower limit, and 0.65 is the best silicon for all-around medium and heavy work, such as is the case for railroad castings.

Manganese.

The manganese may go up a little, but this is not generally advisable, because manganese burns out first in a mixture, and costing money as iron when bought, simply adds to the melting loss. Moreover, with high manganese, there appear annealing difficulties. The above is written advisedly, for one hears many stories of 2 per cent manganese pig iron used successfully in the malleable foundry. Investigation always shows only a limited amount going into the mixtures, the consequent dilution through a large bath poor in manganese wiping out this apparent excess. It may be claimed that high manganese neutralized some of the sulphur by removing it into the slag, but it is far better to begin with low sulphur in the first place, as prevention is better than cure.

Phosphorus.

In phosphorus and sulphur we find the line demarking American from European foundry practice. Whereas we require our phosphorus not to exceed 0.225 per cent, and prefer it as low as we can get it without, however, paying for specially low amounts. European practice has this element as low as we do for acid steel castings. When the first coke irons were introduced into malleable foundries, it was a question whether the comparatively low phosphorus they contained would not militate against proper fluidity on the part of the heat. This proved not to be the case, and hence the irons with phosphorus somewhat above the Bessemer limit of 0.10 per cent are the rule today. As charcoal irons, however, run up as high as 0.225 per cent and are first class for malleable work, the upper limit is as given.

Sulphur.

In the consideration of sulphur we find the surprising fact that Europe makes malleable castings successfully with this element as high as 0.40 per cent, whereas we aim at one-tenth that amount, or 0.04 per cent. Nevertheless, if the sulphur runs as high as 0.07 per cent in the castings we let it pass, and instances have been known in this country of castings being shipped with 0.23 per cent sulphur, but they were certainly beneath all comparison with honest malleable.

We, therefore, call for not over 0.05 per cent sulphur in our pig irons, in order that in making our work we can anneal to the black heart. This is impossible with the European high sulphur irons, where a long anneal at very high temperatures brings about the removal of the carbon by the entrance of carbon monoxide to carry it off, as shown by Dr. Wuest, a German authority on malleable practice. With us, the carbon passes out from the outer portions of the casting in probably another way. The high sulphur in European malleable also accounts to some extent for the comparatively low strength when contrasted with our product. Their castings being all very light, so long as they bend and twist properly, the purpose is served, and hence until heavier castings become the rule instead of the exception, "white heart" and steely looking fractures will remain the characteristic feature of European work.

Total Carbon.

Total carbon is placed at 2.75 per cent in the hard casting, as below

this point there is likelihood of difficulty in annealing. The exact point will naturally vary with conditions. Thus with high percentages of pig iron, the total carbon can drop a little, while with heavy scrap and sprue ratios, 2.75 per cent cannot well be lowered and give safe results. The dropping of the total carbon being entirely accomplished by steel additions carried through a succession of heats, a line can be kept on the work, and the mixtures held within safe limits. For that reason it is not necessary to specify total carbon in pig iron for malleable purposes, a scrutiny of the other ingredients quickly showing whether an iron is an "off" grade. Such irons have no place in the malleable foundry even as a gift, if the highest grade of castings are to be produced.

Pig Iron Specifications.

The specifications for pig iron would therefore run as follows:

	Per cent.
Silicon	0.75, 1.00, 1.25, 1.50, 1.75, 2.00, as required
Manganese	not over 0.60
Phosphorus	not over 0.225
Sulphur	not over 0.05

The lower the sulphur the better. Manganese should run about 0.40 per cent, not very much lower and not above 0.60 per cent, unless purchased with a knowledge of its analysis, and one should see that no more gets into the mixture than will give an average of not more than 0.40 per cent when charged.

Silicon.

Works making heavy castings almost exclusively, specify their silicon to include 0.75 up to 1.50 per cent. Makers of very light work take 1.25 to 2.00 per cent. It will probably be safe for every one to have all the above silicons, but in quantity only as needed. The upper and lower limits, though perhaps not needed once a year, are desirable for emergencies, and need only be kept for that purpose. The time for the large malleable establishments to carry thousands of tons of metal in reserve for such occasions has passed away, except perhaps for those who have not yet learned to mix by analysis. They will keep on paying out good interest on their metal which rusts in the yard.

Pig Iron.

In receiving pig iron from the furnace, as a general rule only the silicon and sulphur need be watched closely. The manganese and phosphorus run pretty steady so long as the furnace is burdened the same way. The writer desires to pay tribute to the furnaces whose products he has used to the extent of hundreds of thousands of tons, never having had to reject a car load. Occasionally the analysis would be not what was desired, but an adjustment of price was quickly made, and the iron went in, a few pigs at a time, scattered over many heats.

Once, therefore, a furnace has been found to send reliable analysis cards with each car, the iron is piled in its respective place and fused, pigs being taken for analysis while this is being done. The silicon is made from these, and every so often the sulphur also. Manganese and phosphorus are taken only occasionally, unless the shipments are noticed as not being normal due to the furnace running "off." In that case, attention must be given to everything. This, however, rarely happens, and the furnaces are particularly careful not to sin by shipping bad iron to a works with a laboratory and brains behind it.

Piling the Iron.

It will be seen that by specifying everything within an upper limit except silicon, and giving that exact, the piling of the iron and its subsequent use becomes a very simple matter. Take for instance a foundry which specifies 1.00, 1.25 and 1.50 per cent only, though having a little of the others on hand for emergencies. This foundry will only have three general piles for every brand it purchases. It is no longer necessary to keep every car load apart, in fact the writer holds this to be very bad practice in the malleable foundry. Say a car load of iron comes in with 1.35 per cent silicon. This should go on the 1.25 per cent pile, the pigs being laid on the ground in a long row, or several rows, as space permits. The next car may contain 1.55 per cent silicon. This would similarly go on the 1.50 pile. Then a car is received with 1.15 silicon. This goes on the 1.25 pile again, the car being spread over the first in a row as before. Gradually, as the cars come in, about 10 points being allowed below the desired figure, and 15 points above, the piles grow in height, and in drawing from the end for charging purposes, an exceedingly uniform metal is obtained. The silicon of the individual cars is determined meanwhile just the same, and should differences arise, the proper correction can be made for mixture calculation purposes, and attention of the furnace called to the discrepancy, so that subsequent shipments may be more correct.

As above stated, each brand should have its separate pile, but the silicons of each may be arranged as above outlined. This limits the piles. The care in marking avoids errors often made, especially as every pile should be designated by the letters of the alphabet and not by names or car numbers. Furthermore, a record of the amounts taken off can be kept in the office, showing at a glance what is left from each respective pile, and how deeply each silicon has been cut into. This for subsequent orders of pig iron.

Brands of Pig Iron in Stock.

It is always a good policy to have three or four brands in stock of the silicons required. Occasionally, however, special reasons preclude this, and one brand only is available. With the piling as above indicated, a heat does not get the iron from only one or two cars, but from 25 cars or even more, and this without a complication of records. The writer at one time had 5,000 tons of iron of one analysis thus piled up in a series of piles. One silicon, one letter of the alphabet designated all these piles, and in mixture making, together with other smaller piles of different silicon content, everything worked without a hitch.

In the system developed by the writer in connection with the above method of piling, he had a report of every daily heat, the weighmaster being under the charge of the laboratory. The charges were delivered to the foundry foreman on the furnace platforms, he getting a copy of every mixture for his information. A record of every brand and silicon pile was kept in so many net tons as they came in. The daily melt was deducted day by day. At the end of every month an order was placed for iron for delivery during the next three months, and so specified for silicon that the relative proportion of the silicon piles was kept normal. Thus, suppose that at normal times the silicon should range as follows:

Per cent.	
0.75	5 per cent of the total iron
1.00	15 per cent of the total iron
1.25	50 per cent of the total iron
1.50	15 per cent of the total iron

If for any reason the high silicon pile were drawn upon heavier than the above ratio, at the end of the month this was corrected by the next iron order. It should be understood that the contracts were made in such a way that this specification for silicon could be given at any time without affecting the price. In case of a special bargain available, a very heavy tonnage was often taken as per the incident above given.

The above has been outlined for a special purpose. In these days of consolidations, and the desirability to be free from exhorbitant prices or imperfect deliveries, it is only a question of time when the very large interests in the foundry business will own their blast furnaces, or else control the entire output of at least one stack. With the method of piling given, it is possible to have only a single brand in the yard and get perfect satisfaction. This is from actual experience. The writer particularly commends this method of piling iron to the attention of malleable men in the interest of uniformity in excellence of product.

Coke Malleables.

The coke irons we purchase today are known as "Coke malleables," formerly they were called "Bessemer malleables," and found an outlet for those irons which would not pass as "Bessemer," on account of higher phosphorus content. The "off Bessemer" irons, which had high sulphur, being palmed off on malleable works also, soon created such trouble that coke iron came into disrepute, and a revival of charcoal metal came about, as explained in the early chapters. Now, however, there is a regular production of pig iron from ores higher in phosphorus than the Bessemer limit, which are incidentally smelted with plently of coke to make them honest, and these give first rate results.

Sprues, Gates and Wasters.

Discussing next the sprues, gates, wasters, scrap hard castings, or whatever they may be called, these are essentially the regular malleable iron in the hard of the daily heats, and should be taken care of as fast as made. As every well regulated malleable works should have the silicon of every heat before the castings go into the anneal, the average silicon from all the daily heats, for the sprues will be known at all times for mixture purposes. The calculation therefore becomes a fairly exact one, and changes in the mixture can be made from time to time, as the silicon of these sprues goes up or down, presuming that the pig iron supply remains constant.

The quantity of these sprues varies with every works. In the case of very light castings, the proportion of the sprues in the daily heats may go as high as 60 per cent, whereas for very heavy work it may not exceed 25 per cent. It is absolutely necessary to use up the material as fast as made, so as not to pile it up in the yard, or have it in the way in the foundry. Once thus stored, it becomes an unknown quantity and may work havoc in subsequent mixtures.

Cleaning Sprues.

A further consideration is the cleaning of the sprues. It is good practice to roll the sprues in a very large tumbling barrel somewhere outside of the foundry to remove the burnt sand adhering. This reduces the amount of slag made, but more important, thoroughly mixes the sprues from the various heats, they being brought to the sprue barrel from the different parts of the foundry floor in the nightly cleaning up. Rolling the sprues at night is advisable, on account of the dust made. The clean sprues are then weighed up and distributed for the various morning heats on the charging platforms. If a heat happens to be higher or lower in silicon than expected, the sprues resulting will be so distributed that no damage will result. The foreman in charge of the weighing, by keeping in touch with the person making the mixtures, can keep him posted as to the supply of sprues to be cared for. In fact the usual custom is to allow a trifle more sprues in the mixture than are actually made, and fill out the shortage with a low silicon pig iron. This keeps the floors clean.

Annealed Scrap.

The annealed scrap is a serious problem for the malleable shop. From the nature of the case, a piece of this material may remain apparently unmelted in a heat until the very last iron is being drawn off. The skin of a casting being almost as infusible as mild steel, the temperature of a bath of malleable is not high enough to melt it easily. The interior of the casting may be fluid, but the shell holds it intact. Hence the general practice of selling this annealed material as scrap, or making annealing pots of it.

The writer took advantage of this peculiarity of the annealed casting to have its interior melted at the ordinary temperatures of the bath, while the skin might be intact, in caring for some 30,000 tons of scrap couplers, which were becoming a financial white elephant to one concern. By crushing these couplers under the hydraulic press, at a cost of about 50 cents a ton, the interior of the castings was exposed sufficiently to allow of a ready melting, and a regular progression of heats was made in which the malleable scrap was charged in increasing quantities until both actually contained 80 per cent malleable scrap couplers. The material had to be charged twice and melted down to get it all into the furnace on account of its bulk. The resulting castings did not have a nice appearance with these high percentages, but they were the strongest ever made.

Steel Scrap.

With the advent of steel scrap in the mixtures, the melting point of the bath has been raised, and at the present time it is quite possible to charge good clean annealing scrap in modest proportions and get results even without the crushing. Formerly a scrap coupler when charged would float about unmelted until the end of the heat, then burn off the skin, with the consequent damage to the iron for castings.

Malleable Scrap in a Heat.

The proportion of malleable scrap in a heat should not generally exceed 20 per cent, depending upon the proportion of sprues to be cared for. In the very large establishments it is customary to take back scrap malleable on account of new castings. Here the above method of caring for scrap couplers means dollars. In the case cited, the difference between pig iron and the malleable scrap at that time, allowing for the cost of crushing was $10 a ton. Hence that pile of 30,000 tons, which was used up in two years, represented a handsome profit. More than this, the use of this material successfully enabled the concern to take any other scrap couplers in exchange for new ones at a high profit, and finally some four carloads a week of home and outside scrap were cared for in this plant.

An investigation of the behavior of annealed scrap in the furnace indicated a heavier loss of silicon than is the case in melting sprues, and hence the advisability of allowing a lower silicon content for this material in the calculations than there is actually present. Thus the annealed castings, being in all probability normal malleable, the silicon ought to be about 0.65 per cent, more or less, generally more. In the calculations this scrap should be held down to about 0.40 per cent, which figure will be found best for the purpose.

Very light malleable scrap is difficult to handle, as it is usually badly rusted, burns, and gives trouble generally. It should rather be used in the cupola for making annealing pots in connection with the proper pig iron for this purpose. A little incident of interest in this connection happened to the writer. One of the officers of a concern had purchased a train load of gray iron scrap under misapprehension as to its use. The price dropped and a big loss was ahead. Incidentally there was an enormous pile of very light malleable scrap in the yard taken in exchange for good castings. The writer added several charges of half gray iron scrap and half of this malleable scrap to the regular run of the cupola for pots, and cast a special pig out of this mixture. This special pig was later fed into the regular malleable heats some 500 pounds at a time. The cost was not heavy for this melting. It saved the loss on the gray iron scrap, used up the small malleable, and made a profit each way, as the castings went for full price and were all right. It also illustrates the fact that when things are running right in a malleable foundry, some liberties can be taken with the mixtures.

Use of Steel Scrap.

Steel scrap in the malleable foundry is now very important, as the total carbon is reduced in this way, and stronger results obtained. Moreover, this addition has cut away every excuse for refining a heat, and the ideal conditions of a quick, hot melt without any refining action other than the unavoidable burning out of the silicon and manganese, should be aimed at. The scrap should be fairly light but not too thin. It should not be charged with the sprues as is frequently done, as it is sure to burn before being covered by molten metal. Steel scrap should be thrown into the bath after this is melted, and gotten under the slag cover as quickly as possible. Steel should not be allowed to burn, otherwise the malleable made will be inferior. The proportion of steel in a mixture will depend upon the amount of malleable scrap used. In any case it should never exceed 10 per cent with no malleable scrap in the mixture.

Wrought Iron Scrap.

Wrought iron scrap seems to be very active when put into malleable heats, as when very much is added the cracking of castings is noticed at once. In general the efficiency of these scrap additions may be said to be as follows: 100 pounds of wrought iron scrap equals 500 pounds of steel scrap, equals 2,000 pounds of malleable scrap, so that substitutions in the mixture may be made accordingly, taking into account, however, the silicon content which is thus disturbed.

Use of Borings.

Borings, whether cast or steel, should, if used at all in a malleable heat, be charged under the slag when the bath is melted. It is better to get rid of the borings in the scale pile, for they are usually rusted and give little in the way of return in melting. Shot, however, from the slag barrel should go into the furnace, the finest preferably under the slag, the coarser with the sprues.

Cast Iron Scrap.

Finally we have the ferro-alloys and cast iron scrap. The latter can be used in small quantities provided no burnt grate bars are included. The small addition of phosphorus introduced into the heat amounts to little, and mention is only made here of the matter so that a concern may know that it is possible to take care of its gray scrap without loss. It practically amounts to just so much pig iron saved in the heat. The quantity used, however, should not exceed 5 per cent.

Ferro-Alloys.

Ferro-silicon is the only ferro-alloy which should be kept in stock at a malleable works for emergency use. Of ferro-titanium and ferro-vanadium, and also ferro-magnesium when this comes on the market, we can only say that their application is too new to give results at this time. The question may safely be left to the future, and when the cost gets to within commercial limits, more will be heard of the matter.

Use of Ferro-Silicon.

There are two ways of using ferro-silicon for malleable purposes. As a high silicon pig in the bath in case of this running "high," and in the ladle as 50 per cent or 75 per cent alloy, in case it is desired to make very small castings from a low silicon heat suitable for heavy work. In the first case it is well to have a car load of pig iron running from 14 to 20 per cent of silicon at hand. Some of this, broken up into small pieces, should be located where the weighmaster can bring it on demand from the foundry foreman or the melter. The amount used should be reported to the office or laboratory, and a record kept. There is a very great tendency to use this material in the heat just before tapping to save the iron, whereas the application of muscle in the first place on the part of the melter in rabbling well, will promote a quick heat and get good iron without the alloy. A long drawn-out heat is always a bad one, and hence the discouraging results when the tactics of the steel melter are introduced into the malleable foundry. The management, by keeping tab on the ferro-silicon pig thus used, will quickly know whether the melters are doing their full duty.

Where, through accident, a heat is lost by burning, the proper thing to do is to add sufficient silicon by means of this pig to get the heat up to the proper silicon content, and then pig the whole bath. This can then be fed gradually into subsequent heats without trouble.

Adding Ferro-Silicon in the Ladle.

Adding high grade ferro-silicon in the ladle is a comparatively new matter to which profitable attention might be given in works where the heavier class of castings is the rule. The discount being heavy for light work in these concerns, it will pay to catch the very last of a heat in a large ladle into which the ferro-silicon has been placed, or fed on the spout as it is let run out. Probably better still, to stop the heat at the right time, add the rich ferro-silicon in the bath, rabble well, and then pour all this iron into light work as usual.

The materials going into a heat having now been discussed, the next matter to be taken up is the calculation of the mixtures.

CORRESPONDENCE SCHOOL OF FOUNDRY ANALYSIS.

The Milwaukee Correspondence School of Foundry Chemical Analysis has been established at 411 Goldsmith building, Milwaukee. The course comprises methods of mixing metal by analysis, as well as the methods of manufacturing semi-steel castings. The first lesson covers the composition of iron which is followed by the methods of figuring heats, semi-steel mixtures, cupola practice, manufacture of chilled cast iron, and closes with a general review covering the chemical reactions that take place in melting iron.

A PRACTICAL FOUNDRY COST SYSTEM

Cost-Keeping Methods Used in the Foundry of the Goulds Mfg. Co., Seneca Falls, N. Y.

THE FOUNDRY cost system adopted by the Goulds Mfg. Co., Seneca Falls, N. Y., has been devised to meet the peculiar requirements of this plant. It was evolved after years of study, and all of the various factors to be contended with have been carefully considered. The system is divided into three parts, as follows: Order system, foundry costs and foundry expenses. They are, however, so closely linked together that a description of each is necessary to outline the entire cost method.

Orders to the Foundry.

Orders are sent to the foundry from the shop production offices on foundry order cards, Form 1. On the face of these cards is stated when the delivery of castings should commence. This order when received by the foundry is entered upon the foundry order record, Form 3, and is then sent to the pattern loft. The pattern is delivered to the foundry a day previous to the date called for on the order, and is sent attached to the pattern. In laying out the work, the molder's name is written on the reverse side of the card, and pattern and card are taken to the proper floor in time for the next day's work.

On the reverse side of the foundry order card, Form 2, is a space on which the time of molding is entered and from which the labor cost of the job is figured. All order cards are turned in daily before pouring off, which gives the foundry clerk time to make up the daily report of castings. One copy is sent to the weighmaster and the other is retained on file in the foundry office. The weighmaster checks each casting received against the daily report of castings, inserts the weights and sends the checked sheets to the machine shop production office, and after the regular procedure in connection with the shop "steering" system it is delivered to the cost department.

Foundry Order Record.

The foundry order record was devised for the purpose of enabling the foundry office to plan its work intelligently. It will be noted that all orders, filled or unfilled, are recorded upon this card, as is also the daily production of the section in question, and comparisons are made weekly of this data with the amount planned for the week to meet the requirements of the production departments. This form has been found to be particularly well adapted to small castings made in large quantities, another form being used for the larger castings which require individual tracing.

Cores are ordered simultaneously with the patterns. The "plan" column of the foundry order record gives the foreman of the core room the rate per day at which the cores are to be produced for each job, which expedites matters in the core rooms.

Sorting the Castings.

All patterns are provided with metal raised letters so that the pattern number can easily be seen on each casting. This makes it an easy matter to identify each different heat in the sorting room. After the castings are sorted they are placed in individual shipping boxes, the various classes being kept separate, and each box contains an individual shipping bill, Form 4, to provide for the easy checking of the castings by the weighmaster. Large castings are sent through the scratch room instead of the sorting department, but are likewise identified by their pattern number. Form 5 shows the weekly defective report. On this are listed the defective castings and the reasons for their defects are indicated. B.H. indicates that the castings contain blow holes; C.O.C., core off center; W.P., wrong pattern; L.T., leaky under tests; W.D., wrong dimension, etc. These reports are made weekly for each plant, the blanks being 8½ x 11 inches in size. In its three pattern storage buildings the Goulds Mfg. Co. carries a stock of more than 400,000 patterns, not including obsolete designs which are, however, occasionally called for on repair orders.

Cost System.

The costs are divided in two general divisions, hand pump and triplex. The hand pump castings are again divided into three classes according to the nature of the molding, cores, etc. The cost per pound for each class is obtained weekly. The triplex castings are treated individually for costs, and are grouped under classifications for estimating purposes according to their type, weight, etc. The expense system is closely allied with the foundry cost

ORDER NO.	REF NO.	DATE	DEPT.
MAKE	PART		

FIGURE	SIZE	MATERIAL	PATTERN NO.	SHEET NO.

Wanted ..... Signed .....

KEEP RECORD OF PIECES MADE ON THIS ORDER ON BACK OF CARD AND RETURN TO OFFICE BEFORE POURING OFF.

FORM 1—FOUNDRY ORDER CARD, 3 x 5 INCHES

DATE	NAME	HOURS	NO. OF PIECES
	KEEP TIME TO QUARTER HOURS.		

FORM 2—REVERSE SIDE OF FOUNDRY ORDER CARD

FIG. _____ SIZE _____ PART _____ SHEET NO. _____ PATTERN NO. _____

ORDERS					SHORTAGE			ORDERS							
Date	Quantity	Order No.	Wanted	Filled	Date	Quantity	Filled	Date	Quantity	Order No.	Wanted	Filled	Date	Quantity	Filled

Week	Plan	MADE						Total Week	Forward	Total	Week	Plan	MADE						Total Week	Forward	Total
		M.	T.	W.	Th.	F.	S.						M.	T.	W.	Th.	F.	S.			

FORM 3—FOUNDRY ORDER RECORD, 5 x 8 INCHES

system, the reports of the former being the medium from which the latter is obtained.

Direct Labor.

The direct labor report, Form 5, is made up weekly. The reports of the cost of the molders and helpers in the iron and brass foundries, and the core makers in the core rooms of these two departments are entered upon this blank as well as the production in pounds of these various departments. The production for the iron foundry is divided into production of uncored machine castings, production of cored machine castings, production of small floor castings, triplex castings, etc. From the cost of the direct labor and the production, the cost per pound of the direct labor for both brass and iron foundries can be easily obtained.

Indirect Labor.

Indirect labor of the iron foundry includes melters, general shop work by molders, cost of pouring off, labor on defective molds, crane men, laborers on mash, overtime of molders and general foundry helpers. The indirect labor in the brass foundry is also figured in the same way. The indirect labor in the core department includes shop work by core makers, overtime of core makers, and the cost of laborers and helpers. In the tumbling room the box operators, grinding operators and wheelers are charged to indirect labor. Other indirect labor costs include the storekeeper of the store-room, store-room laborers, general foundry yard laborers, general foundry superintendent and foreman, clerks, carpenters, machinists, flask transportation, pattern transportation and general labor. From the production of the iron and brass foundries, core room and other departments, the indirect labor cost per pound is ascertained.

Direct Materials Report.

The direct materials report, Form 8,

From Foundry, Goulds Mfg. Co.

Shipped to _____ **Date** _____

Quantity	Fig.	Size	ARTICLE	Pattern No.	Material	Received by

IN CASE OF ANY ERROR, RETURN BILL PROMPTLY TO FOUNDRY OFFICE.

INDIVIDUAL SHIPPING BILL.

FORM 4—SHIPPING BILL, 8¼ x 5¼ INCHES

WEEKLY DEFECTIVE REPORT.

Plant No..... Date..... Week Ending.....

B. H.—Blowhole. C. O. C.—Core off Center. W. P.—Wrong Pattern. S.—Sandy. B.—Broken. L. T.—Leaky Under Test. W. D.—Wrong Dimension. S. S.—Scant Stock. Sp.—Spoiled on Machine.

DATE	No.	PART	FIG.	SIZE	MAT.	DEFECT.	WT.	LABOR CH.	MAT. CHG.	DEPT.

FORM 5—WEEKLY DEFECTIVE REPORT, 8½ x 11 INCHES

which is made up weekly, contains a column in which are entered the shipments that are charged to the various departments and the number of castings received, and in another column is entered the total pounds of castings received, defective castings returned and net finished castings. A space is also left for the cost of the metal per pound of finished castings, and the percentage of foundry defectives to total charged as well as finished castings total charged, are also estimated.

Indirect Materials Report.

Form 9 is the indirect materials report. This includes a column for the iron foundry on which are charged molding sand, facings, fire brick, chaplets, bellows, riddles, brushes, etc. Against the brass foundry are charged the crucibles, molding sand and other materials similar to those used in the iron foundry. The core room charges include core and molding sand, core compounds, linseed oil, flour, resin and other materials. The indirect materials

GENERAL FOUNDRY—DIRECT LABOR REPORT

For Week Ending..... Date..... Signed.....

Cost Department.

		No.	D-A			Pounds
Iron Foundry—Uncored Work on Machines	Molders		A-1	Production of Uncored Machine Castings	Iron	
" " " " "	Helpers		A-1	Total Direct Labor Uncored Machine Castings	"	
" " Cored " "	Molders		A-1	Direct Labor, per pound, " " "		
" " " " "	Helpers		A-1			
" " Small Floor Work	Molders		A-1	Production of Cored Machine Castings	"	
" " " " "	Helpers		A-1	Total Direct Labor, Iron Foundry	"	
" " Triplex Work	Molders		A-1	" " " Core Room	"	
" " " "	Helpers		A-1	Direct Labor, per pound	"	
				Production of Small Floor Castings	"	
Brass Foundry—Uncored Work on Machines	Molders		B-1	Total Direct Labor, Iron Foundry	"	
" " " " "	Helpers		B-1	" " " Core Room	"	
" " Cored " "	Molders		B-1	Direct Labor, per pound	"	
" " " " "	Helpers		B-1			
" " Small Floor Work	Molders		B-1	Production of Triplex Castings	"	
" " " " "	Helpers		B-1	Total Direct Labor, Iron Foundry	"	
" " Heavy or Triplex Work	Molders		B-1	" " " Core Room	"	
" " " " "	Helpers		B-1	Direct Labor, per pound	"	
				Production of Uncored Machine Castings	Brass	
Core Rooms—Machine Cores for Iron Foundry			C-1	Total Direct Labor	"	
" " Small Floor Cores for Iron Foundry			C-1	Direct Labor, per pound	"	
" " Triplex and Heavy Cores for Iron Foundry			C-1			
				Production of Cored Machine Castings	"	
				Total Direct Labor, Brass Foundry	"	
Core Rooms—Machine Cores for Brass Foundry			C-1	" " " Core Room	"	
" " Small Floor Cores for Brass Foundry			C-1	Direct Labor, per pound	"	
" " Triplex and Heavy Cores, Brass Foundry			C-1			
				Production of Small Floor Castings	"	
				Total Direct Labor, Brass Foundry	"	
Other Direct Labor Charges				" " " Core Room	"	
				Direct Labor, per pound	"	
				Production of Heavy or Triplex Castings	"	
				Total Direct Labor, Brass Foundry	"	
				" " " Core Room		
				Direct Labor, per pound		

FORM 6—DIRECT LABOR REPORT, 8½ x 11 INCHES

GENERAL FOUNDRY—INDIRECT LABOR REPORT

For Week Ending_____ Date_____ Signed_____

Cost Department

	NO.	D. A.		NO.	D. A.
Iron Foundry—Melters		A-10	Store Room—Storekeeper		F-30
" " General Shop Work by Molders		A-20	" " Laborers		F-30
" " Pouring Off		A-20			
" " Labor on Defective Molds		A-20			
" " Cranemen		A-30	General Foundry Yard—Laborers		G-30
" " Laborers on Mash		A-30			
" " Overtime of Molders		A-30			
" " General Foundry Helpers		A-30	General Foundry—Superintendent and Foreman		H-30
			" " Clerical		H-30
			" " Carpenters		H-30
Brass Foundry—Melters		B-10	" " Machinists		H-30
" " General Foundry Work by Molders		B-20	" " Flask Transportation		H-30
" " Pouring Off		B-20	" " Pattern "		H-30
" " Labor on Defective Molds		B-20	" " General Labor		H-30
" " Cranemen		B-30			
" " Laborers on Mash		B-30			
" " Overtime of Molders		B-30			
" " General Foundry Helpers		B-30			
Small Core Dept. Shop Work by Coremakers		C-10			
" " " Overtime of Coremakers		C-10			
" " " Laborers and Helpers		C-30			
Triplex Core Dept.—Shop Work by Coremakers		C-10	Iron Foundry—Total pounds produced		
" " " Overtime of Coremakers		C-10	" " Indirect Labor, per pound		
" " " Laborers and Helpers		C-30	Brass Foundry—Total pounds produced		
			" " Indirect Labor, per pound		
			Total production, less Triplex and Uncored		
Rattle Box Room—Box Operators		D-30	Small Core Dept.—Indirect Labor, per pounds		
" " " Grinder Operators		D-30	Production of Triplex Castings, pounds		
" " " Wheelers		D-30	Triplex Core Dept.—Indirect Labor, per pound		
			Total production, Iron and Brass, pounds		
			Depts. D-E-F-G and H, Indirect Labor, per pound		
Scratch Room—Cleaners		E-30			

FORM 7—INDIRECT LABOR REPORT, 8½ x 11 INCHES

for the grinding rooms include emery wheels, wire brushes, wheelbarrows, etc.; scratch room, wire brushes, wheelbarrows, pneumatic hammers, chisels, etc.; foundry storage houses, supplies and miscellaneous materials.

Summary of Foundry Costs.

From these various expense reports the general summary of foundry costs, Form 10, is made up. On this are entered the total pounds of finished castings in both the iron and brass departments, and the direct labor per pound in these two departments, as well as in the core rooms. Columns are also provided for the indirect labor and material expenses, and power, light and heat administration and selling, special charges and depreciations are also estimated by the pound. The direct charges include direct material, such as gray iron, cost per pound and total cost per pound, and for the brass department, phosphor bronze, red brass and yellow brass. From these reports the total cost per pound of all the castings produced in the two shops can be ascertained. The castings produced in the iron foundry are divided into the following classes: Uncored machine, cored machine, small floor and triplex castings; in the brass department, uncored machine, cored machine, small floor and heavy castings. These reports are filled out weekly, the data being received by the main office in such shape that one man can easily compile the figures.

GENERAL FOUNDRY—DIRECT MATERIALS REPORT

For Week Ending_____ Date_____ Signed_____

Cost Department.

CHARGED	D-A	WT.	@	
				Total pounds of Castings Received
				" " Defectives, etc., Returned
				" " Net Finished Castings
				Cost of Metal per pound of Finished Castings
				% Foundry Defectives to Total Charged
				% Shop " " "
				% Finished Castings to " "
Product				
CHARGED	D-A	WT.	@	
				Total pounds of Castings Received
				" " Defectives, etc., Returned
				" " Net Finished Castings
				Cost of Metal per pound of Finished Castings
				% Foundry Defectives to Total Charged
				% Shop " " "
				% Finished Castings to " "
Product				

FORM 8—DIRECT MATERIALS REPORT, 8½ x 11 INCHES

GENERAL FOUNDRY—INDIRECT MATERIALS REPORT

For Week Ending _____ Date _____ Signed _____ Cost Department

Q	ARTICLE	D-A
	IRON FOUNDRY	
	Tons Moulding Sand	A-50
	Lbs. Lead Facing	A-50
	Lbs. Mineral Facing	A-50
	Lbs. Talc "	A-50
	Lbs. Seacoal "	A-50
	No. Fire Brick	A-50
	Lbs. Fire Clay	A-50
	No. Chaplets	A-50
	Materials Charged from Invoice	A-50
	Bellows	A-50
	Riddles	A-50
	Soft Brushes	A-50
	Pattern Brushes	A-50
	Blackwash Brushes	A-50
	Camels Hair Brushes	A-50
	Swabs	A-50
	Miscellaneous Materials	

OPERATION AND CARE OF THE CUPOLA*

Latter-day Practice Discussed by an Experienced Foundryman—Furnace Repairs

BY W. S. ANDERSON

THERE is no department of the foundry where the conditions that must be harmonized for success vary more widely than those I have encountered in cupola operation. Many foundrymen, particularly those of the old school, claim that cupola practice is one of individual aptitude or judgment, in other words, that there can be no cut-and-dried system of operating their cupolas. Therefore, it is reasonable to expect that no two cupolas have the same melting ratios, or capacity, or are producing the same quality or quantity of metal under apparently the same conditions.

Our chemists who give us the exact contents of elements in our stock or fuel cannot defend themselves against the adverse results that are obtained through the improper melting of the stock. That chemistry is of value to the foundryman has been demonstrated, but that value can be destroyed by bad cupola practice. A melter can destroy the results of any chemist's work. Every melter should know that the theory of melting in a cupola is based on the space occupied by the fuel and iron and not upon the heat producing units of fuel consumed in the process.

Melting Zone.

It is estimated that only one-fourth of the heat units of fuel consumed in the cupola are available. Not one pound of iron can be melted in a cupola until it reaches the point which is called the melting zone. The point where this zone is located in the cupola varies with the quality of fuel and the volume of blast. It is usually 10 to 12 inches in depth, and may be confined to a depth of 6 to 8 inches. To do good melting, this zone must be definitely located, and upon the amount of fuel, blast, etc., depends the amount of metal that can be properly melted. A large volume of blast gives a high melting point, and a small volume a low melting point. A soft combustible fuel gives a high melting point, and a hard fuel a low melting point, the blast being equal in volume with both fuels.

The design and principle of operation of the cupola and the blast furnace, are similar, but the cupola provides the cheaper method of melting iron because of its direct contact with the fuel. It obtains the maximum absorption of heat, and the amount of fuel consumed varies from one-fourth to one-twelfth of the weight of iron according to the temperature desired. The higher average is only reached when the melting is continuous or of long duration.

The cupola is divided into five sections or zones. First, the crucible zone, sometimes called the hearth; second, the tuyere zone; third, the melting zone; fourth, the charging zone; and fifth, the stack.

Crucible Zone.

The crucible zone extends from the sand bottom to the tuyeres. The object of this zone is to hold the molten iron and slag as it drops below the tuyeres. If the tap hole is kept open all the time this zone may be shallow, and not to exceed 4 to 6 inches from the sand bottom to the bottom of the tuyeres. If it is desired to hold molten iron as a reservoir the height of the tuyeres must correspond to the amount of metal to be held. Metal can be melted at a higher temperature with low tuyeres and can be collected in a ladle with better results than by holding it in the cupola.

Tuyere Zone.

The tuyere zone is where the blast comes in contact with the fuel. This is where combustion starts and all the heat is generated for melting the metal. This zone is confined to the area of the tuyeres which should be equal to not less than one-fourth of the area of the cupola at this point. The combined area of the tuyeres should equal three times the outlet of the blower when it is of proper size for the cupola. Volume of blast, and not velocity, is considered in regulating the tuyere system.

The fuel, when the cupola is in operation, blocks the area of the tuyeres at this point and only the crevices between the fuel through which the blast may escape represents the tuyere area. Therefore, a small tuyere is more readily blocked than one of larger area. Small tuyeres give velocity, large ones, volume.

Melting Zone.

The melting zone is the space immediately above the tuyeres and extends upward 24 to 30 inches, depending on the pressure of the blast that enters the tuyeres. It is also regulated by the area of the tuyeres, pressure of blast and volume of blast. With high pressure the point will be raised, with low pressure and volume it will be increased in depth. The melting zone cannot be regulated by the fuel, no iron is melted above it or below it.

Charging Zone.

The charging zone is that part of the cupola that contains the charges of iron and coke, from the upper part of the melting zone to the charging door. The stack is the continuation of the cupola through the roof which depends on the location, buildings, etc., for its height and dimensions. The contraction of the stack above the charging door does not increase nor decrease the efficiency of the cupola in any way. It may reduce the cost to the extent of confining the gases and heat at the charging door, which is destructive to the lining, doors, etc., at this point.

Repair of the Cupola.

The first operation of the melter is to chip out his cupola. It is well to slush down the sides from the charging door with one or two buckets of water to lay the dust. A bar that will reach from the charging door to the tuyeres made of 1¼-inch gas pipe, with a heavy, flat, pointed chisel on the end will aid in removing the heavier accumulated slag. It is not advisable to chip too closely to the brick, that is, to remove the glaze, as this is more refractory than the brick. The slag will be found adhering very

*Read before the Cincinnati Foundry Foremen's Association.

strongly at the top of the tuyere zone to the bottom of the melting zone. This should not be permitted to build up, as it does not allow the molten iron and slag to drop freely to the bottom. By building up at this point it reduces the capacity of the cupola.

Daubing or repairing the lining of a cupola should be done with the best materials. Too often a cheap material is used which has no refractory properties. It readily falls off into the stock, melts, runs over the tuyeres, exposes the lining, which is further burned out, with the result of slow melting, dirty iron, etc. Enough slag can be produced from clean iron and fuel without the addition of poor cupola daubing. A good refractory fire clay well mixed with mica or gannisters should be used.

In daubing up the melting zone of the cupola, not more than one inch in thickness should be put on, except to repair small holes, and then small pieces of fire brick should be used to reduce the quantity of clay. Every cupola forms its own bosh, and the problem of maintaining its shape should be understood by every melter.

Sand Bottom.

The sand bottom or hearth of a cupola should be of a quality of material that will not melt and form a hard mass. It must withstand the action of molten iron running over it without cutting. It should be open enough to let the gases escape freely and should not be too wet nor be rammed too hard. Frequently we hear melters say, "The wood fire on the bottom will dry it out." This is an erroneous idea. Wet bottoms cause the iron to boil, frequently cutting through to the bottom doors, or making a chilled bottom. This will produce dull iron for some time, and makes tapping a difficult job until the iron gets hot enough to cut this chill. Instances of this kind can be observed in the boiling and cutting of sand in large runners for heavy castings and of chilled bottoms in ladles. The slope of the bottom has much to do with the temperature of the iron, and is more marked in a slow melting cupola. The pitch of the bottom to the tap hole should not be so great as to throw the molten iron with force against the breast, as when the iron is tapped out it comes out with too much velocity, and it is almost impossible to run a continuous stream or to control it in the spout. Slag always flows freely from the tap hole of a high-pitched bottom, making it hard to stop up with a bod. The bottom should be made flat and smooth, with a well-tamped fillet of sand at the edge or next to the brick, and the bottom pitch to the tap hole should not exceed one-half inch to the foot. The spout should be in line with this bottom.

The Breast.

The breast or front of a modern cupola is made small so that it is not necessary to use any but a good strong refractory clay that will not crack in drying. This is where the tap hole is located. In cupolas melting a large amount of metal, running for several hours, it has to withstand severe usage in tapping, and should retain the metal without cutting. The tap hole should not be more than 1¼ inches long, and of a diameter to admit of running a stream of metal of the capacity that the cupola is melting continuously, and should be made of material that will always insure a regular size through the entire heat.

Slag holes are located opposite the tap hole and at the top of the sand bed. They should be built out on the top and undercut, that their thickness at the hole will not be more than one inch.

After the cupola is repaired it is ready for the wood fire to kindle the coke bed. Only enough wood and kindling should be used to properly ignite the coke, and the coke placed on the kindling in quantities that will allow the bed to burn up evenly, as an uneven or side burned bed will not correct itself throughout the entire heat.

The Coke Bed.

No definite, or even approximate, weight can be given of the amount of fuel required for a bed in cupolas of different diameters, as the tuyeres are placed at such a variety of heights above the sand bottom. All the coke below the tuyeres is not available for melting; it only assists in bearing the burden of the charges above it. After the blast is on this coke practically dies out or remains partially ignited. The bed proper extends from the tuyeres to the top of the melting zone. This must be replenished after each charge of iron is melted. If the fuel is in excess, the melting will be slow and irregular. If the amount of coke that occupies the melting zone is not enough to melt the iron placed on it the iron will settle below this zone and cannot be melted. If the amount of coke is too great the iron melts slowly and fuel is wasted.

It is, therefore, a matter of space occupied or filled by the fuel rather than the weight of the fuel. If the coke is heavy, increase the amount of iron on the charges; if light, decrease it. Do not attempt to increase the amount of coke and still retain the same weight of iron in the charges with light coke. Light coke will melt less iron proportionately and heavy coke will melt more. The proper remedy in melting, when coke is poor, is not to increase the coke, but to reduce the weight of iron in the charges.

Charges of Coke and Iron.

The charges of coke and iron should be maintained uniformly throughout the entire heat. In mixing iron to obtain uniform metal at the spout much care should be exercised in the charging. To obtain these results, pig iron should be broken and well distributed. The quality of the iron will largely depend on the care and management of the cupola. The best of irons can be rendered useless by careless cupola practice, and a seemingly poor iron can be used successfully, by careful management.

Regarding fuel ratio, do not attempt to save a few bushels of coke at the expense of dull iron. Fast melting does not always mean economy, while slow melting does mean extravagance. Hot iron for clean castings, and dull iron for dirty ones.

The melting of iron in a cupola is an art. It is the greatest resource of profit to the foundryman when properly managed, and when not properly operated, results in heavy losses. Scarcely one melter in a hundred understands the theory of melting iron in the cupola. At best, the melter's job is a thankless task, dirty, dangerous and poorly paid. There is no incentive for a young man to learn this trade. Foundrymen take laborers and map out a routine for them from the foundry office, with a 10 to 1 ratio for melting, and their job depends on their meeting these requirements, which are often exceeded on paper by heats run in the foundry office.

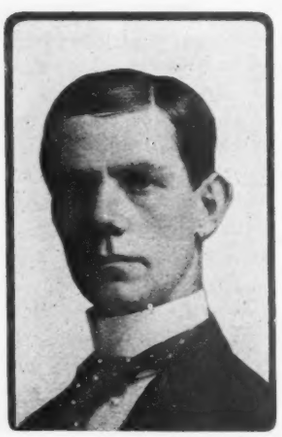
INSTITUTE OF METALS.

Invitations have been sent to smelters, manufacturers, merchants, metallurgists, engineers and scientific men, interested in the manufacture and use of the non-ferrous metals, to attend a meeting on June 10 at the Institute of Mechanical Engineers, Storeys Gate, Westminster, London, for the purpose of organizing an Institute of Metals. Those desiring to aid in the formation of this organization are requested to send their names to Wm. H. Johnson, care of Rd. Johnson, Clapham & Morris, Ltd., Manchester, England.

METHOD OF MOLDING A DOME CASTING

A Simple Method Possessing Novel Features of Interest to the Foundryman as Well as the Apprentice

BY W. W. McCARTER



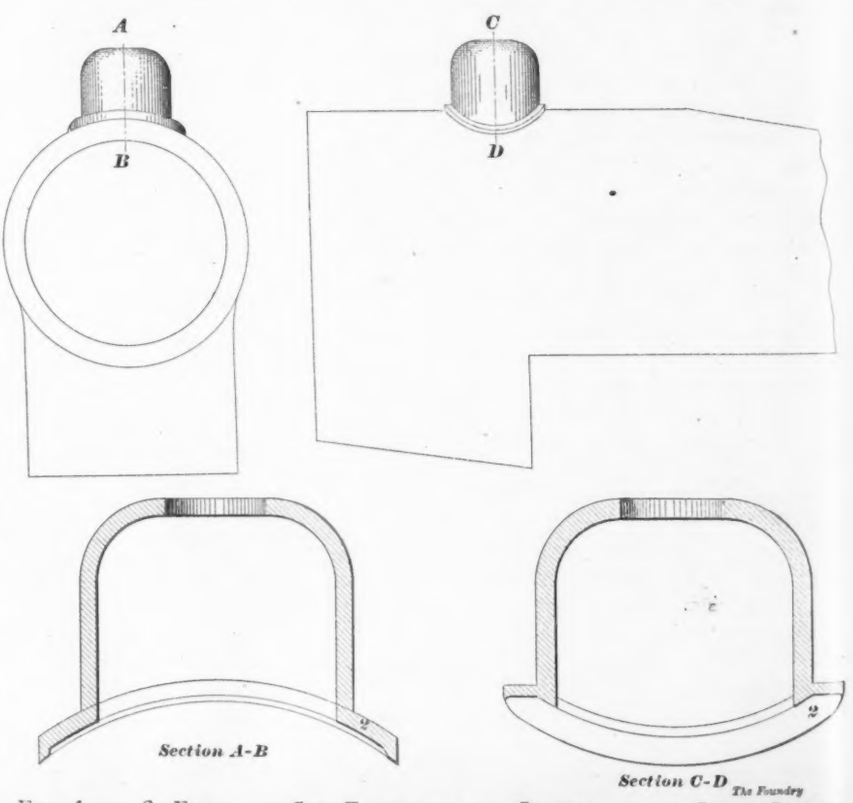
THE various methods pursued in performing work of a like nature undoubtedly differs according to the number of shops engaged in making that line of work. Every foundry has its own standard or system, and this may be good or bad, according to the practice. The question of changing from one method to another is, however, a serious one and should receive careful consideration. The method of molding the dome casting, shown in the accompanying illustrations, from a metal pattern, is not a new one, but nevertheless will prove interesting to many molders and foundrymen.

Two views of the dome, which is made of rather thin metal, are shown in Fig. 1, and cross-sections on the lines AB and CD are shown in Fig. 2; Fig. 3 is a section through the drag on the line AB; Fig. 4 is a vertical section of the flask on the line CD, which also shows a sectional view of the pattern. The section through the pattern on the line CD, is shown in Fig. 5. It also shows the inverted position in which the pattern is placed for the purpose of ramming up the core before swinging it on the crane. Plan and cross sections of the flange are shown in Fig. 6; Fig. 7 shows the plan and cross sections of the core plate, and Fig. 8 is the plan of the cope. The core plate 1, as shown in the cross section of the drag, Fig. 3, is supported upon a bed of sand, which has been previously swept up. Fig. 5 shows a section of the pattern opposite that illustrated in Fig. 3, without the flange.

When beginning operations the bottom plate 3 is placed on the floor in a suitable location where ample space will be provided for handling the cope and cheek after they are rammed up. The drag is placed on the bottom board, rammed up and struck off by sweep 4, which travels on the joint of the drag in the direction of the two opposite inclines. This leaves a raised bed on the same incline as that of the drag, on which the core plate 1 rests, as shown in Fig. 3, in which an opening is provided by removing some of the sand from the center to admit the nut and washer at the end of the tie bolt. A portion of the bed thus swept up is cut away. This includes that portion that comes within and extends beyond the flange.

The pattern containing the horizontal rod and the tie bolt is placed in an inverted position on the floor, as shown in Fig. 5. Sand is tucked to the interior surface and the core is rammed up in this way from heap sand, the tie bolt being tucked to approximately the center in the meantime. The core is then pierced with a long vent wire after which the plate 1, which conforms to the shape of its bottom surface, is bolted, thus tieing the green sand core to the interior of the pattern. It is then swung up by means of the beam and slings, shown in Fig. 5, rolled over and lowered upon the bed which has already been prepared for it.

Regarding that portion of the bed which has been cut away, it might be well to state that the flange pattern Fig. 6, is placed upon the area of the drag immediately after the raised bed has been swept up by sweep 4. A mark is made with the trowel on the inside of the flange, about 2 inches from its side, intersecting the raised bed. The sand between this mark, on the inside of the drag, is cut away to a depth



FIGS. 1 AND 2—FRONT AND SIDE ELEVATIONS AND SECTIONS OF THE DOME CASTING

The Foundry

of 2 inches. The flange pattern is dropped into this circular channel before the pattern is lowered upon the raised bed.

The reason a part of the bed is cut away is to provide a space for tucking under the flange which, in this case, is bedded in. It naturally follows that the outer edge of the core plate is also tucked and bedded in, as a result of which the core is subjoined to the drag, and is made as stable as though the drag had been rammed up with it and rolled over in the usual way. The stability of the core largely depends on the method of gating the casting. If the mold were gated on the side in one or more places, as would be necessary if the casting had a thicker metal distribution, the core without anchors would be very unstable. Inasmuch as the mold is gated on the top with three sprues of equal size cut at equal distances from each other, permitting the metal to enter the mold with equal lateral pressure, there is no danger of the core moving on account of the absence of anchor rods, which, in work of this kind penetrates the sand in the drag.

After the joint has been made and the horizontal rod removed, the cheek is put on, being guided into place by three loose pins which enter through the flanges, two of which are shown in Fig. 4. These pin holes are not spaced equal distances from each other; two of them are located opposite each other, while the third is placed at a point nearer the one than the other which makes it impossible to close the flask the wrong way.

The side bars in the cheek reach to a point within half an inch from the flange and side of the pattern, the same space intervening between the bars of the cope and the pattern. The gage 5 is used to divide the distances between the pattern and the inside of the drag. The raised bed on which the core plate rests insures the location of the top of the pattern and the correct distance from the bars of the cope. It is obvious that no gaggers, nails, soldiers nor rods are required. By simply tucking the bars and giving the cheek and drag an ordinary peening and butting, the work of producing a casting of this shape and metal thickness is reduced to a minimum.

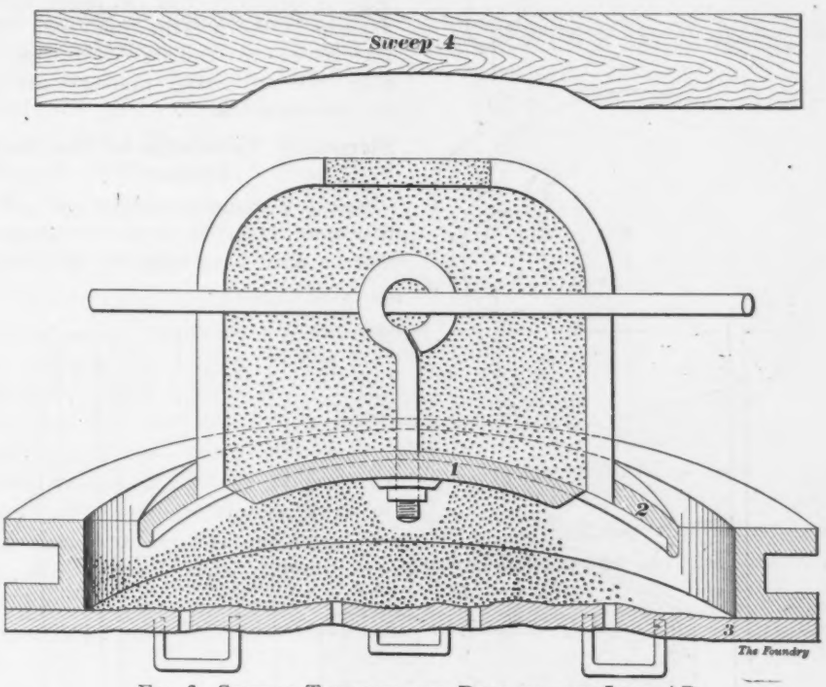


FIG. 3—SECTION THROUGH THE DRAG ON THE LINE AB

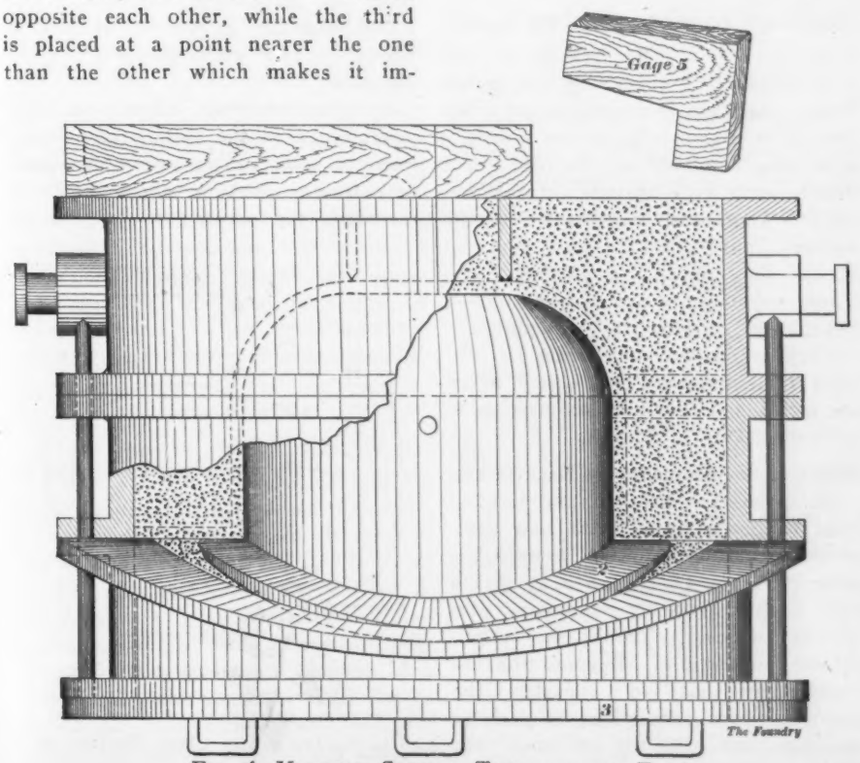


FIG. 4—VERTICAL SECTION THROUGH THE FLASK

As shown in Fig. 4, after the cope has been lifted off the body of the pattern is withdrawn; the cheek is then lifted off, which permits of the withdrawal of the flange, which is telescoped up over the core. The long pins serve as guides for the cheek in every instance.

DIFFICULTIES WITH A COMMUTATOR SEGMENT.

BY C. VICKERS

Question:—We are having considerable difficultiy with commutator segment castings. Each segment is 1⅞ inches thick, 3 inches wide on the top and 2 inches on the bottom. The castings show up perfectly on the outside, but seem to be hollow inside, and there is every indication of segregation where the gates are cut. The castings are well vented, both in the cope and drag, with a riser at one end. The metal is poured very dead. Our mixture consists of copper, 100 pounds; tin, ½ pound; antimony, ¼ pound; and zinc, 2 pounds. The tin and antimony are added to the copper about 10 minutes before it is taken from the

furnace, and the zinc is added when we are ready to pour.

Answer:—The primary cause of your troubles with these castings lies in the mixture. The zinc is the only deoxidizing element contained therein, and it is insufficient in quantity. It should be increased to five pounds. The antimony does little good and should be left out entirely. The method of gating is poor. You will get better results by running the metal from one end as described in the article on silicon-copper, published in the March number of THE FOUNDRY. I recommend a careful study of the methods of gating described in this article.

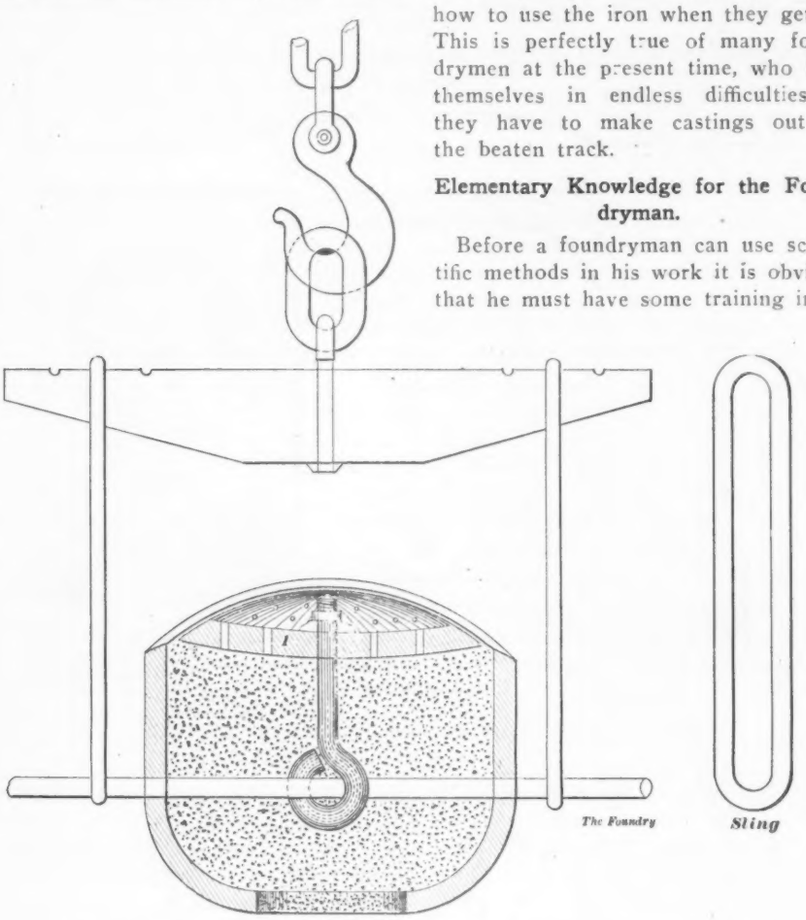


FIG. 5—INVERTED POSITION OF THE PATTERN FOR RAMMING THE CORE

THE APPLICATION OF SCIENCE TO FOUNDRY WORK.

BY G. B. WATERHOUSE

At a recent meeting of the Royal Society of Arts held in London, a paper was read on "The Application of Science to Foundry Work," by Robert Buchanan. His paper was, of course, given from an English standpoint, and the illustrations were drawn from English practice; there is, however, much that may be directly applied to our conditions.

The great advantages of mixing irons by analysis were emphasized. Blast furnace operators buy their ores, fuels and limestone by composition, but many have a marked disinclination to sell their product by analysis. They raise the objection that if they did this, most foundrymen would not know how to use the iron when they get it. This is perfectly true of many foundrymen at the present time, who find themselves in endless difficulties if they have to make castings out of the beaten track.

Elementary Knowledge for the Foundryman.

Before a foundryman can use scientific methods in his work it is obvious that he must have some training in at least elementary chemistry and metallurgy. All that is necessary for a beginning is a knowledge of the principles governing combustion; the function of fluxes, such as limestone, in forming suitable slag; and the influence of the various constituents of cast iron, so far as they affect the general body. These constituents are carbon, silicon, phosphorus, sulphur and manganese.

They are taken up in order to consider their influence, how they affect the metal, and how each may be made subservient to the founder.

Effect of the Elements on Each Other.

All questions of brand and number must be put aside, and the new compounds must be made by exactly the same methods as the chemist makes his. Each deals with elementary substances, which combine in certain definite proportions. Beyond this the foundryman has to consider the changes which take place in melting the iron, and also the influence that the size of the casting has upon the ultimate product, owing to fast or slow cooling.

The amount and kind of carbon is almost wholly controlled by the other constituents present. The presence of sulphur, the absence of silicon, or quick cooling of the metal, each or all of them cause the greater part of the carbon to take the combined form. Low sulphur, with silicon present to the extent of 3.5 to 4 per cent, with slow cooling, cause almost the whole of the carbon to take the graphitic form. The graphitic form means softness, and as the combined carbon increases so does the hardness. The influence which silicon has upon the quality of cast iron was wholly misunderstood until Prof. Turner made his memorable investigations and experiments. It was formerly believed to be a hardener in all percentages, but now we know that it only begins to harden iron when 4 per cent and over is present. With less than 4 per cent it acts wholly as a softener.

This it effects by causing the carbon to assume the graphitic form. Another very important function of the silicon is to increase the solubility of the metal for gases, or in other words to obviate porous castings.

Manganese.

Manganese has the effect of hardening cast iron, but in ordinary cast irons this is not noticeable, even when it reaches 1.75 per cent. From another point of view it is a softener because it removes much of the sulphur as manganese sulphide. This either slags off, or remains in the iron, where it acts very similarly to the graphite.

It also combines vigorously with any oxygen in the metal, removing it into the slag, and so promotes sounder castings. Another effect is that it increases the power of the iron to

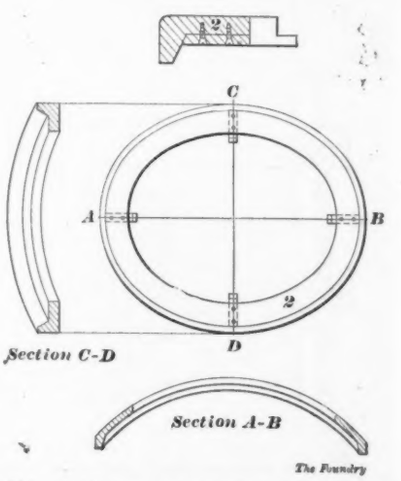


FIG. 6—PLAN AND CROSS SECTION OF FLANGE

dissolve carbon, and so is directly opposed to silicon. It is to be noted that its influence in producing combined carbon is greatly exceeded by that of silicon in producing graphite.

Phosphorus.

Phosphorus plays an important part in the melting, casting and structure of cast iron. Up to 1.70 per cent it occurs as the phosphide of iron. It has a marked influence on the rapidity and consequently the cost of melting. The phosphide has a low melting point, and melts within the iron long before the mass shows any signs of fusion. In this way the fusion point of the whole iron is lowered, and it is seen that phosphoretic irons can be melted with a coke consumption impossible of attainment in the case of purer metal. Phosphoric irons run fluid and the castings have a nice smooth skin. The fluidity comes from the iron having a low melting point, and the smooth skin from the iron not having an erosive or "searching" action on the mold.

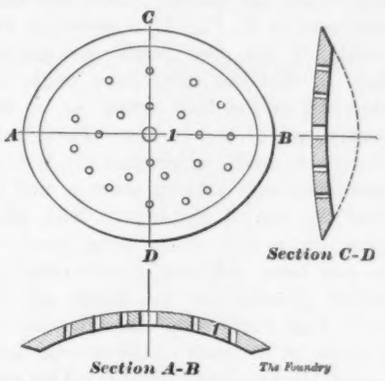


FIG. 7—PLAN AND CROSS SECTION OF PLATE

Unfortunately, phosphorus does not continue its beneficence further than the melting and casting. When there is present from 1.25 to 1.50 per cent, the castings do not readily resist shock, and such percentages have a very weakening effect in general. For the highest strength phosphorus should be from 0.20 to 0.40 per cent. For fluidity combined with strength, from 0.70 to 0.9 per cent, and for fluidity combined with a fair amount of strength, there might be one per cent or slightly over. No constituent exceeds sulphur in active influence, and unfortunately this influence is almost wholly not beneficial under ordinary conditions. Hence the anxiety to keep it as low as possible.

To properly safeguard against the use of high sulphur iron the only way is by buying on analysis, and then taking care that the coke used in melting is also low in this element.

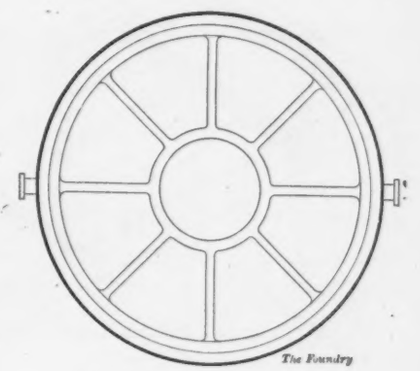


FIG. 8—PLAN OF COPE

MOLDING A NARROW FOUNDATION PLATE

BY JABEZ NALL

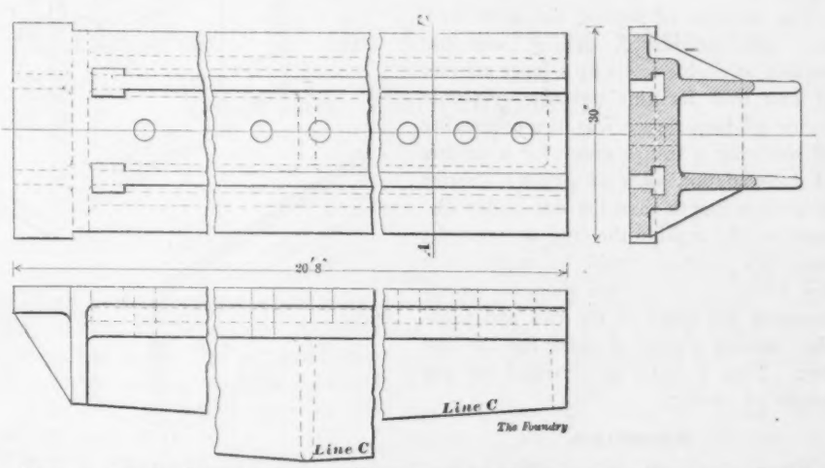
MUCH HAS been written about the relationship of the pattern shop and foundry, and the necessity for harmonious operations between these two co-related departments. Wherever harmony does exist between the two, better work can be accomplished than where disputes frequently arise and discord holds sway. Frequently, co-operation will result in better and cheaper methods, and while the expense to one department may be greater than to the other, nevertheless the resulting economies will be beneficial to all.

Foundation Plate.

As an example of this, there is described in this article the method of making a long and narow foundation plate, shown in part plan and part elevation in Fig. 1, and in cross section in Fig. 2, on the line AB, Fig. 1. The casting was 20 feet 8 inches long and 30 inches wide, and while an order had been received for only one, nevertheless, it was probable that addditional plates would be called for in the future. The cheapest method of producing the casting was sought, and the reasons for adopting this method of making the pattern and the mold are given below.

Saving in Pattern Cost.

To make a complete pattern of the casting, having core prints for the T-slots and for the round holes, would also require a special cast iron cope flask, as it was necessary to cast with the face side down. The estimated additional cost of a full pattern, as compared with the plan adopted, included 25 hours of labor and 235 feet of pattern lumber, and the saving effected in pattern shop expense alone was $26.25. The cope flask for



FIGS. 1 AND 2—PART PLAN AND ELEVATION OF FOUNDATION PLATE AND CROSS SECTION ON LINE AB

the full pattern would have required an inside measurement of 25 feet in length and 38 inches in width, and no less than 30 bars would have been required. The estimated cost of this flask was $75.

The making of the cope in cores required 10 core bars, but this expense was again offset by the number of gaggers that would be required for the cope.

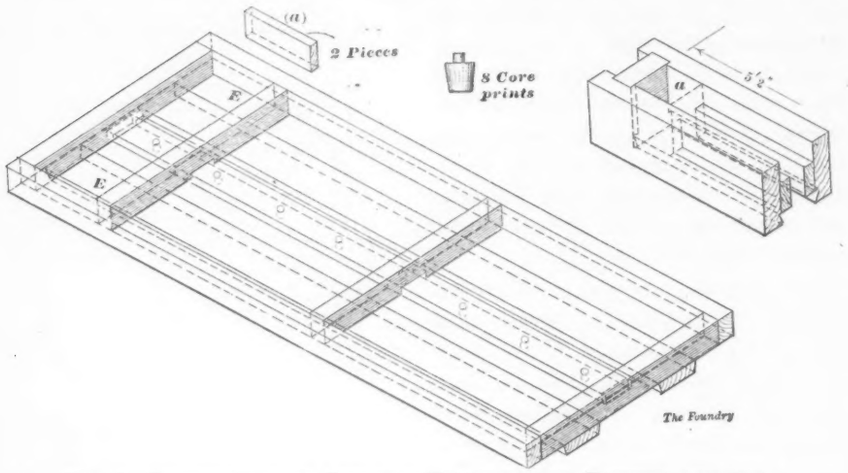


FIG. 3—CONSTRUCTION OF SKELETON FRAME OF THE PATTERN AND THE T-SLOT CORE BOX

Question of Storing Complete Pattern.

The question of storing the pattern also received consideration, inasmuch as a pattern of this size would be inconvenient to handle in the pattern storage. In all shops, storage space is at a premium, and patterns not standard nor frequently used, are stored in out-of-the-way places. To make this pattern in two parts would have facilitated storage, by permitting it to stand on end, and in this way it would not have taken up much more space than the core box and frame used, but by doing this we would have lost one of the principal advantages of a complete pattern, inasmuch as we would have had to depend upon the molder for a straight casting.

The question of storing the large flask was also considered, and it was not deemed advisable to tie up a large amount of cast iron for this purpose. Another factor of importance was the probability of receiving a future order for a casting of a foundation plate of either a shorter or greater length than the one under discussion. By making the cope in cores the necessary changes could be made in a few hours in the pattern shop, by merely changing the taper of the ribs and probably making a stop-off piece for the last core. Thus it could be arranged for any length of casting.

Advantages.

Another advantage derived from forming the bed, or the under side of the casting when in the mold, by a frame or skeleton pattern, was the saving of molder's time. He also had a better opportunity to ram this part of the mold, to secure the edges of prints and to do all the necessary venting, etc., while the frame pattern was in position. This insured sharp edges and straight lines for the T-slot cores without extra work. If a pattern is used and bedded in, much of this work must be done twice.

Construction of the Skeleton Frame.

Fig. 3 shows the construction of the skeleton frame of the pattern, which was 8 inches greater than one-quarter the length of the casting. This allowed for the placing of core print D in the imprint left by core print C when the pattern was reset after first ramming. Holes for this line of prints were bored on the correct centers, and thus continued down the line, but all of these were not used on the last setting. Extra core bars were used at E, Fig. 3, to permit of the cutting of the core prints for the T-slots, so that the short piece might be taken off at the last setting, or at the bracket end of the casting. These core prints were made wider than the slot, in accordance with modern practice, and to avoid the use of chaplets to hold them down, the weight of the metal lying on the core being sufficient to overcome any upward pressure on the flange of the core. This frame was made the correct thickness of the plate of the casting, with a finish allowance of 3/8 inches. This was found sufficient, as the casting was practically straight when cool.

Core Box for the Cope Cores.

Fig. 4 shows the core box for cope cores as arranged for the middle cores at the highest point of the rib. Piece a, which formed half of this rib, was left loose in the box and acted as a separator for ribs B, keeping them on the correct line, these ribs making these two cores. To

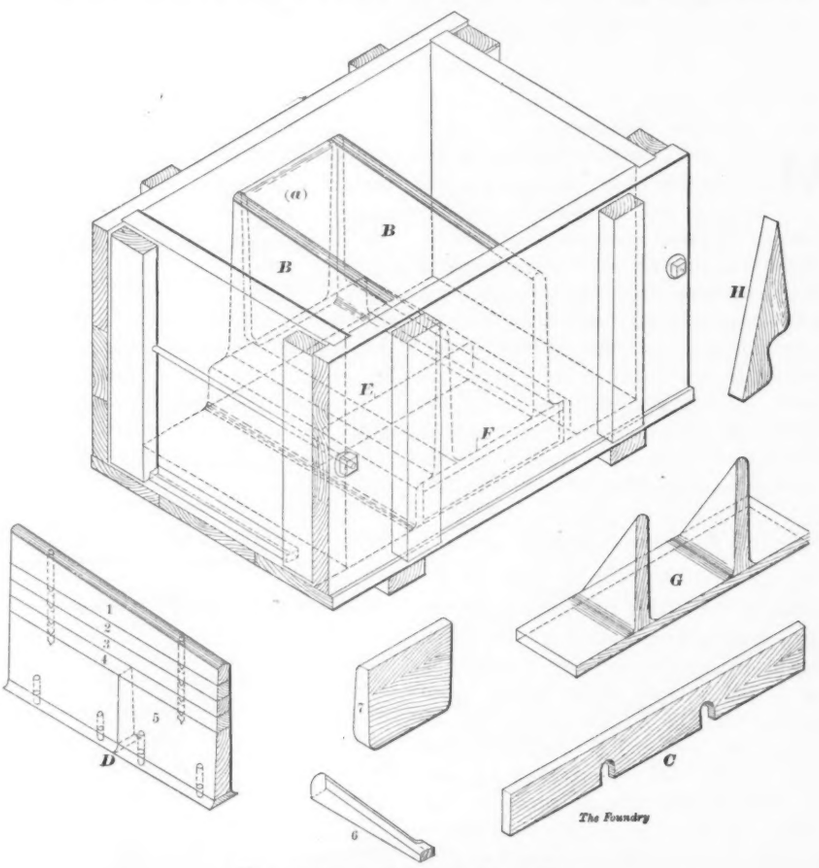
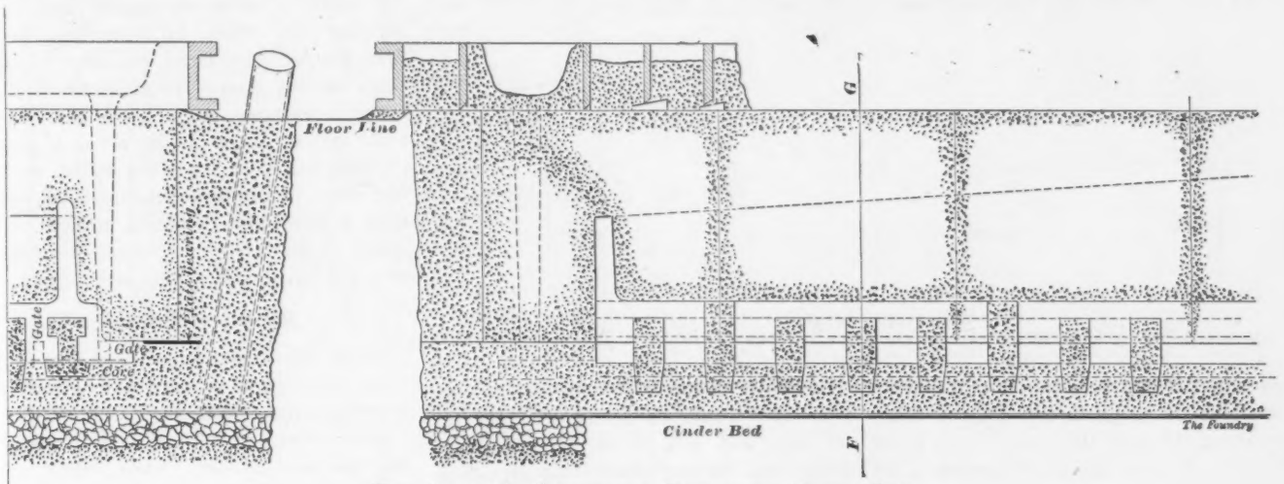


FIG. 4—CORE BOX FOR COPE CORES

keep these ribs in place for the other cores, a straddle piece was slipped over them temporarily, this piece having been of the same length as the inside of the box. The detail of ribs B are shown at D, Fig. 4. These parts were dowelled and screwed together, so that for each pair of cores after the first two mentioned, the top piece 1 was removed and pieces, 2, 3 and 4 were taken out in order. Piece 1 was replaced each time until eight cores had been made, then piece 5 was removed and piece 6 replaced piece 1. This was made right and left hand for opposite ribs. The block on the bottom board, Fig. 4, was arranged in two parts, jointed at E and part F was removed, ribs B being arranged short length were then put in place, separated by piece 7. This arranged the box for the end core, except that two upright runners for gates were rammed in place in this core. To arrange for the bracket end of the casting, bracket G was set against the parts already in the box and the ribs H were placed in position. The T-slot, core box, shown in part in Fig. 3, requires little explanation. It was arranged for four lengths of cores on each side, a block not shown being inserted at a after the first two cores had been made. Except for the making of two round cores to fit the taper prints shown, this completed the pattern work.

Molding.

While the molding operations were simple, they required considerable care to insure a straight casting. A hole was dug of sufficient depth to bring the top of the cores slightly above the level of the floor line. A cinder bed was used to carry off the gases, and sand was rammed on top of this bed and leveled. The frame pattern, Fig. 3, was then set in position at one end and a line was stretched parallel with the pattern, and was left in place until the mold was completed. This line was used as a guide. Plates were set in at the top of the mold as indicated in the cross section, Fig. 5. To support the cores at the last setting of patterns, pieces A, Fig. 3, were backed on at the sides at the end of the frame to form the projections of the bracket. This finished the T-slot cores and the round cores were set in place. The bottom skin was dried and in this way all fins on the T-slot core joints were avoided. Gates, as shown in Figs. 5 and 6, were previously cut.



FIGS. 5 AND 6—SECTIONS OF FOUNDATION PLATE MOLD

Top Cores.

The setting of the top cores was then in order. These were marked to insure the matching of the ribs, and they were set beginning at the smallest end of the casting. For the swelling of the core 3-16 of an inch was allowed, and this also provided for any fin between the cores. By carefully making these cores this allowance proved sufficient, and when the 10 cores were set together they were exactly the desired length. After the cores were set, heap-sand was rammed around them level with the top. While any flat cope or as many as required will answer, we used two iron copes, the vents from the cores being carried in small channels underneath to the outside. The cores were wedged beneath the bars and the copes were screwed down. The gates and risers were carried through the cope plates, the casting being poured from both ends.

Economy of the Method.

Two molders and one helper worked two days making this mold, which was a considerably shorter time than would have been required to make the mold in green sand. The casting was sound and clean and as core fins were very light, little chipping was required. The time spent on these 10 additional cores, as compared with those required for a full pattern, averages 2½ hours each. This is offset by the saving effected by not using the cope flask. It is evident that as a result of the friendly co-operation between the pattern shop and the foundry, the molding and pattern shop cost was greatly reduced. As for the method itself, it can in varied form, according to the shape of the casting, be applied with economy in many instances, and to many patterns.

A Discussion of the Core Print Question With the Patternmaker

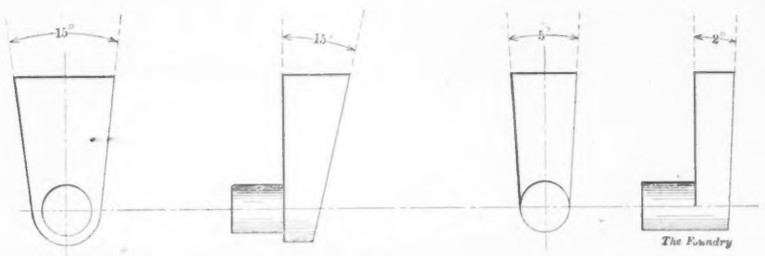
BY N. E. YORKER

I THOUGHT I would call around this morning, Mr. Patternmaker, to see if I could get you to change the core prints on this grinder frame pattern that you sent down last night. We will need four metal patterns and I thought it would be well to take the matter up with you before we made them.

"You will notice that the total angle sidewise of these six stop-off cores is less than five degrees, while the end angle is but two degrees. You will remember that on the last pattern of this kind you sent down, the prints were about the same as these, and at that time I called your attention to the fact that the prints should have a very liberal amount of draft, especially on the back, to enable the molder to set the cores quickly, removing the danger of shaving the sand with the end of the core and crushing the corners of the prints, leaving a heavy

fin on the casting and also a ragged and dirty looking ear where the sand had fallen into the mold. You did not see fit to correct this matter, and as a result I have been severely criticized every time a lot of those castings came through, and a large number have been returned.

"O, yes, I know that you have always made them that way and that there are hundreds of shops throughout the country doing the same thing, and I also know that all of these shops are getting a lot of very poor castings as a direct result of this little mistake. Now, if you will make the total angle sidewise of these cores 15 degrees and the end angle the same, we shall be able to drop them into place instantly, without the least danger of injuring the mold. The core can be made long enough to cut through clean, and a perfect casting will be assured.



WHAT WE WANT STOP-OFF CORES WHAT WE GET

Size of the Stop-Off.

"There is another matter I wish to speak of in this connection. In many classes of work it frequently happens that these cored holes must be made larger than originally intended, and if we are able to ream out the core box 1/16 or ⅛ of an inch we are soon out of our trouble. But as these boxes are usually made, with the bottom of the stop-off the same diameter as the body of the core, it is a very difficult matter. If you will make the diameter of the bottom of the stop-off ⅛ of an inch larger than the body of the core we shall always be prepared for any emergency, and the casting will not be injured in the least. I have made these sketches showing the cores as they are at present and the way I suggest having them made.

Accumulation of Duplicate Core Boxes.

"While we are on this subject of cores, Mr. Patternmaker, there is another point that I am sure would make things easier for me, save you some work and also save the company a considerable amount of money in the course of a year. I have recently had occasion to look over our 50 years' accumulation of core boxes, amounting to many thousands, and was greatly surprised at the large number of duplicate boxes among the collection.

"In one case there were 25 boxes of the same diameter for a plain round core, and they did not vary more than ¼ of an inch in length. Of course, the boxes were numbered for different patterns, but the fact stands out clearly that the company has paid for making 24 useless core boxes, simply because the patternmaker did not know that core box A207 was one inch in diameter and 3½ inches long. This box would have answered for the 25 jobs, and will, hereafter, as I have broken up the rest rather than give them shelf room.

"Of the straight round cores with taper prints a large number of duplicate boxes were found, insofar as the diameter of the core and the length through the metal are concerned, but the prints were of all lengths and tapers. In fact, out of 21 boxes of the same diameter and practically the same length but two could be said to be exact duplicates because of the prints. It is evident that every man who made one of these boxes had his own idea as to the length and amount of taper the prints should have, and his ideas changed every time he made a box. However, they were all pretty much alike in one respect, the cope print had a little more taper than the drag.

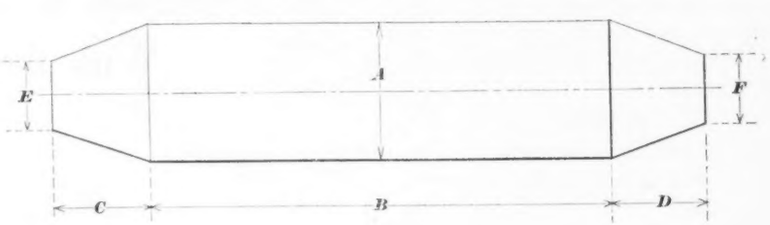
Prints of Uniform Length and Taper.

"Right here I want to register a good hard kick against this practice because of the extra care that is required in setting these cores and the losses that are often sustained by setting them wrong end up. With this kind of a core a man must examine every one before he places it in the mold, and even then, in cases where the difference in angle is slight, he will occasionally set them wrong. In my opinion, there is no good reason why we should not have a uniform length and taper for the prints in both cope and drag for a very large majority of all cores of this class. An angle of 35 degrees is certainly enough for the cope print and the core can be set in a print of this angle in the drag more easily and much more quickly than can be done with a print that is nearly straight. A length of seven-tenths the diameter of the core will be found entirely satisfactory.

Record of Boxes.

"Now, Mr. Patternmaker, if you will make the prints of stop-off and plain round or square cores along the lines that I have mentioned. I feel safe in saying that we will produce much better and cleaner castings and at a lower cost. I will get out a list of all core boxes we have at present and furnish you a copy, which should surely prevent the making of duplicate boxes. I have brought along this sketch to show the method of making this list. This method could also be followed in the case of stop-off cores if standard angles and a standard diameter and thickness for the bottom of the print for each size core were adopted. And as you make hundreds of patterns each year requiring cores of this kind, many of them being located the same distance down from the parting line and coring through the same thickness of metal, it is evident that one box would answer for a great many patterns that at present require special boxes because of the various sizes and shapes of the prints.

"O, yes, I know that a 12-inch stop-off core would be very large at the top end, using the angles I have given, but I venture to say that among our very large



Number	A	B	C	D	E	F
B 290	1″	3 1/2″	11/16″	11/16″	1/2″	1/2″
D 308	1″	3 3/4″	3/4″	5/8″	7/8″	5/8″

The Foundry

TAPERED CORE WITH TABLE OF DIMENSIONS

THE FOUNDRY DATA SHEET, MAY, 1908.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

Measuring the capacity of ladles.

(Continued from Data Sheet No. 17.)

The accompanying tables are based on a taper in all the different size ladles of 1½ inches to the foot. However, a ladle might differ from this taper considerably without materially affecting the results.

The dimensions given in the table are all in inches, and the sizes of ladles are based on their diameter inside the lining at the bottom. The lining of a ladle thickens with use, and when this thickening is sufficient to affect the results new measurements should be taken, and the column in the table corresponding to its new diameter must be used. Allowance must also be made if the bottom thickens.

The gage which is used in connection with this table, and the method of using same is shown in Fig. 2. The gage consists of a holder as shown in Fig. 1, and a bar of iron to fit the same with graduations 1 inch apart, each graduation being stamped with the capacity of the ladle at the corresponding depth. The sketch shows the gage for an 8,000-pound ladle. As will be seen, the same holder will do for all ladles, but a different bar should be provided for each ladle. This, however, is not absolutely necessary, for if a bar is provided long enough to suit the deepest ladle, it can be used on the smaller sizes as well by obtaining from the table the number of inches of iron it is desired to take, and setting the gage by measurement to suit the same. The sketch makes the method of using very plain. Any shape bar will do for a gage bar, but a flat bar about 1 × ⅜ inch is preferred.

The sketch also shows the holder set at 5,508 pounds of iron. If it is desired to gage this same amount of iron in the same size ladle without using this form of gage, all that is necessary is to turn to the table and find the column for a ladle 32 inches in diameter at the bottom. Then find in this column the figure corresponding to the amount of iron it is desired to take, in this case 5,508 pounds, and look for the corresponding figure in the column denoting how many inches must be taken, which in this case is 25 inches. This depth can then be marked on the inside of the ladle, or can be gaged by any of the methods heretofore described.

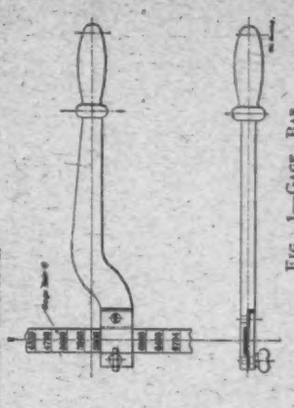


Fig. 1—Gage Bar.

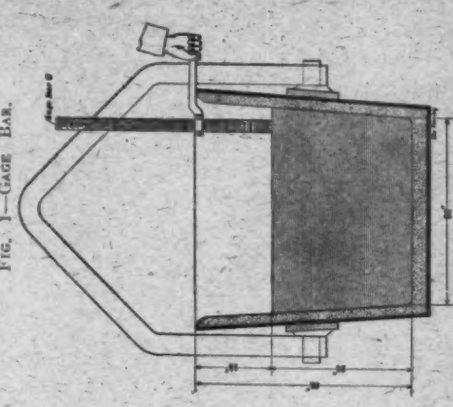


Fig. 2—Measuring the Amount of Iron in an 8,000-Pound Ladle With a Gage Bar.

Table Showing the Capacity of Ladles at Each Inch of Their Depth, from 25,000 to 45,000 Pounds Capacity.

Data Sheet No. 18. The Foundry, May, 1908.

Measuring the capacity of ladles, and an easy method of ascertaining the amount of iron in ladles with a gage bar.

Table Showing the Capacity of Ladles at Each Inch of Their Depth, from 18,000 to 25,000 Pounds Capacity. Table is Based on a Taper of 1½ Inches Per Foot.

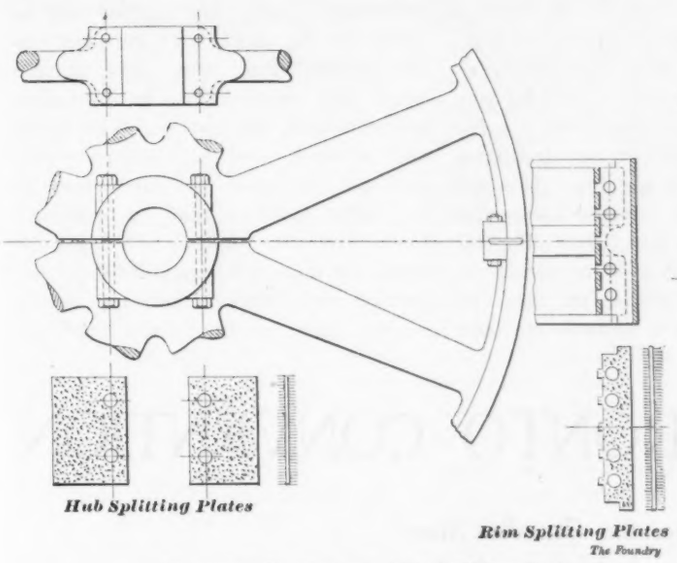
(Continued on Data Sheet No. 18.)

Diameter of ladle at the bottom in inches.

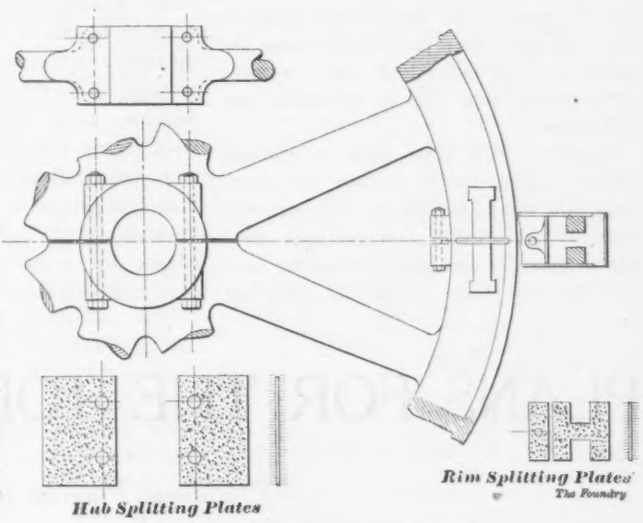
Data Sheet No. 17. The Foundry, May, 1908.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

assortment of patterns you will not find a single core of this kind more than five inches long, while you will find several thousands from ¾ to 2 inches in length. These are the cores I am after, and when it comes to the very long core I shall be glad to make an exception in that case and take lesser angles."



SPLITTING PLATES FOR BAND WHEELS



SPLITTING PLATE FOR FLY WHEELS

SPLITTING PLATES FOR BAND AND FLY-WHEELS.

BY ALBERT E. BOLTON

Many different methods of splitting pulleys, from 6 to 22 feet in diameter and ranging in weight from 4,000 to 75,000 pounds, are pursued in foundries throughout the country. Every firm making a line of engines has its own method of splitting wheels. Some use cores which very often fuse or break, especially when a deep faced wheel is made. Others use steel plates covered with asbestos, which make sparks fly all over the shop while the mold is being cast. After having tried cores made of practically every mixture invented with only a fair degree of success, I concluded to adopt some other method, and the one described herewith I believe to be the best and safest yet devised.

I have been using the splitting plates shown in Figs. 1 and 2 for four years, and in that time have made no less than 200 fly-wheels. During one year we made 110 wheels using these plates entirely, and have had some of them relined several times without the least trouble. The plates are made as shown in the illustrations, using No. 16 brads. The brads should be beaten to the plate, but not flattened against it, just enough to make the plate rough. The plate is then laid between two flat weights and the weights are hammered until the plates are even. The plate is then coated with either thin paste or molasses on top of which a layer of plumbago, ⅜ inch, is spread. The plate is then dried and when it is taken from the oven it will be cracked to a slight extent. Liquid plumbago blacking should then be spread over the entire plate. It is generally understood that large wheels are split in the foundry, and the foundry foreman, with the aid of one or two chippers, does the work.

When splitting wheels with plates a different method must be pursued than when spliitting them with cores. In my practice I always have the plates cut through the top and bottom of the wheel, and then put a straight edge across the face and run a chalk line. A groove is then cut the width of the face, ¼ of an inch in depth or a little less than the wheel has to finish. The wheel is then split entirely from the hub, using short pieces of rail and steel wedges about 12 inches in length. Thus far I have only had to turn over one wheel and it had 2½ inches of metal on the rim. It was 18 inches in diameter and had a 36-inch face. I allow from 1 to 1¼ inches of metal on the rim, leaving when finished ¾ to 1 inch of iron. If less than one inch of metal is allowed in the rough, wheels from 14 to 20 feet in diameter, they will split themselves in the process of cooling which frequently results in oblong wheels.

BANQUET OF ERIE FOUNDRYMEN.

Erie foundrymen were guests of their employes at an elaborate banquet given at the Reed House, Erie, Pa., Saturday evening, April 4, by the Erie Foundry Foremen's Association. This affair was the fifth annual dinner since the formation of the organization, the foremen having been guests of their employers last year. Iron was tapped at 8 o'clock, and the menu, disguised in foundry terms, reflected the culinary department's masterful knowledge of the founders' art. William F. Grunau, head of the association, presided, and toasts were responded to as follows: "Proprietors' View of the Foundry Foremen's Association," Thomas E. Durbin; "Men and Management," Harry E. Kies; "Foundry Pig Iron," Edward H. Williams; "How We Organized," H. F. Giehle; "20th Century Alchemy," James A. Evans; "Treatment and Mechanical Education of the Apprentice," Fred Leighton; "Educational Feature of the American Foundrymen's Association," H. M. Lane; "The Association," Matthew Griswold Jr.; "Foundry Advancement," A. O. Backert.

Handsome aluminum souvenirs, made by the Griswold Mfg. Co., Erie, were distributed. They consisted of a tobacco box in the form of a molder's bellows and a pipe modeled after a ladle, lined with fire clay.

CRACKING OF MALLEABLE CASTINGS.

BY RICHARD MOLDENKE

Question:—We are making castings which we find almost impossible to mold and cast without cracking. The casting is 15 inches in diameter, 3 feet long and

has a core 1¼ inches thick. The metal around the core is ⅜ inch thick. The flanges at the center are ⅞ inch thick and at the outer edges ¼ inch in thickness. These castings frequently crack in two or three pieces while they are still hot, and these pieces are again frequently cracked in several more pieces a day or two after they have been taken out of the sand. We have tried chills in the drag part over the center where the metal is 7-16 inch thick, but we have been unable thus far to overcome our difficulties.

Answer:—You have quite a problem ahead of you, but if thought out carefully you should be able to overcome the difficulty. You must first get your casting so that you can take it from the sand red hot and then anneal the red hot casting in a way similar to which brake wheels are treated before they are packed with scale for the regular annealing. Your castings are evidently so full of strains and these are so intense, that you cannot hold the metal together even when hot. This shows that either your metal is too hard or the core is too hard, or both. Placing chills would seem to make matters worse, as these immediately set up severe strains, which account for your trouble. You should first make a softer mixture, using little or no steel scrap with 50 per cent of pig iron. This will give you metal with a smaller contraction than you probably now have. For the thickness of the hub of your casting, the silicon can easily be 0.65 per cent and over and still have it white in the sand. You should have a small oven ready fired up red hot, into which to place these castings, drawn red hot, in fact, just as soon as set, and the castings should be kept at this temperature for several hours, permitting the oven to cool down very slowly over night. The following morning the castings will be ready for the anneal. To get your silicon higher than you have it, you must add ferro-silicon in the ladle before pouring the castings. This would not compel you to change your methods for your regular work. It is better, of course, to eliminate steel, excessive sprues, and annealed scrap, for these will give you heavy contraction and interior shrinkage, which, in this case, results in the cracking.

PLANS FOR THE TORONTO CONVENTION

Provisional Program for the Canadian Meeting of Foundrymen—Exhibition Feature

THE INTEREST already manifested by both American and Canadian foundrymen, as well as manufacturers of foundry supplies and equipment, foreshadows a record attendance at the foundrymen's convention to be held in Toronto, June 8-12. Many members of the Foundry Supply Association, which will have charge of the exhibit, have already taken space, more than 75 per cent having already been allotted in Machinery Hall. Many reservations have also been made in the Process building. Arrangements have been made for the installation of a large amount of labor-saving machinery for making and handling the molds, for preparing sand, etc., and the indications are that this exhibit will be the most complete of its kind that has yet been undertaken. For the first time in the history of the trade, all branches of the iron and brass foundry industry will be shown under actual operating conditions. The operating exhibits will include core ovens, cupolas, brass melting furnaces, as well as molding machines, etc. Still exhibits will be confined to the Process building.

The provisional program, as outlined by Dr. Richard Moldenke, secretary of the American Foundrymen's Association, follows:

Monday morning, June 8—Exhibition will be ready.

Monday evening—Meeting of the Associated Foundry Foremen.

Tuesday afternoon, June 9—Formal opening of the convention and exhibition. Joint meeting of the American Foundrymen's Association, American Brass Founders' Association, the Associated Foundry Foremen and Foundry Supply Association.

Tuesday evening—Official reception at the city hall.

Wednesday morning, June 10—The exhibition will be closed, while the business session of the association is in progress. The American Brass Founders' Association will hold a meeting in a separate building.

Wednesday afternoon—Business session.

Wednesday evening—Open.

Thursday morning, July 9—The exhibition will be closed during the business session of the association.

Thursday afternoon—Business session.

Thursday evening—Moonlight excursion on the lake.

Friday afternoon, June 12—Trolley ride.

Friday evening—Smoker.

A ladies' reception committee has been appointed to entertain the ladies during their visit in Toronto. Automobile rides, shopping expeditions and theater parties have been outlined. The same rule which governed the Philadelphia meeting will be strictly adhered to regarding the entertainment features.

Inasmuch as the annual dues of the American Foundrymen's Association are only $5 a year, all foundrymen not already enrolled in this organization are urged to send their applications to Dr. Richard Moldenke, Watchung, N. J. The meetings of the association can, however, be attended by all foundrymen, free of charge.

A special invitation has been extended to European visitors, who are in Toronto at the time of the meeting. They will be gladly welcomed and cared for if they make their presence known to the secretary. Visits to foundries in Toronto and other large Canadian cities will also be arranged.

A marked departure from the usual program of these meetings is contemplated. Live subjects are to be discussed, several of which have already been selected, and these will be introduced systematically by able speakers. No elaborate papers will be read. More material is, however, sought by the association, and Dr. Moldenke urges all foundrymen to send questions of special interest to him as soon as possible.

Until after the convention, Henry M. Lane, secretary of the Foundry Supply Association, will remain in Toronto, and all correspondence appertaining to exhibits should be addressed to him, in care of the Toronto Foundry Co., Ltd., Toronto.

The invitation to hold the convention of the American Foundrymen's

Association next year in Cincinnati, extended last year at the Philadelphia meeting, will be renewed in Toronto by Cincinnati foundrymen who will attend the Canadian gathering in June. The old Machinery Exhibit building connected with the Music Hall will

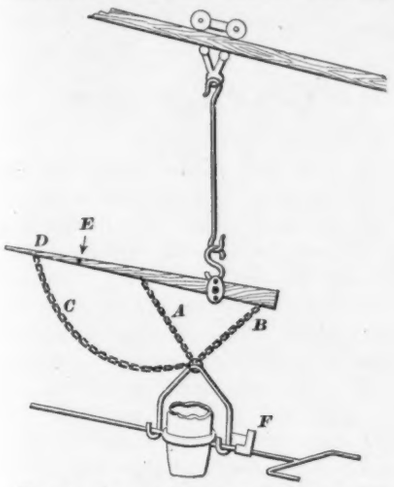


FIG. 1—LADLE HANDLING DEVICE FOR BRASS FOUNDRIES

afford ample facilities for the foundry equipment exhibit, and the auditorium of the Music Hall will be used for the business sessions. The building is centrally located, within 12 minutes walk of the principal hotels.

A NOVEL METHOD OF HANDLING METAL IN BRASS FOUNDRIES.

BY FRANK R. ZELLER

To facilitate the handling of metal in our brass foundry we have adopted the device shown in Figs. 1 and 2. It is likewise economical and relieves the force of much of the labor of pouring off by the old method formerly followed. Although the device is very simple it is extremely effective, and any inexperienced man can be taught to pour the most difficult work in a few days.

The ladles are handled by two men, neither being compelled to carry any weight, and the shank tilts so easily that the power has full control. Two laborers can easily handle from 20,000 to 30,000 pounds of metal daily, and as the work is not heavy the necessity of replacing them every few days is obviated.

To operate this pouring system most effectively the molds should be arranged in rows on either side of the trolley and a pouring level should be obtained. The device should be adjusted so that the top bar D, Figs. 1 and 2, is level, and the chains A and B are taut, while chain G is slack. The lip of the ladle should be three or four inches above the mold. Slightly tilting the ladle will start the metal, and as the pourer has no weight to carry he is always in control of the flow of the metal. The laborer at the straight end of the shank merely steadies the ladle by pressing his knee against the end of the shank.

When the ladle is empty, the laborer at the straight end of the shank forces down bar D, and by slipping a link of chain C on hook E, the ladle will remain in position without any pressure on the bar until it is again necessary to raise it. While pouring it is not necessary to force down the bar. By properly adjusting the ladle from 6 to 10 molds can be poured without raising it. The ladle can be raised, however, in a very few moments by forcing the bar down and the slack in chain C can be taken up by slipping a link over hook E, as shown in Fig. 2. This throws the weight on chains B and C, leaving chain A slack.

This device is especially adapted for tilting furnaces, one of the Schwartz type being shown in Fig. 3, raised

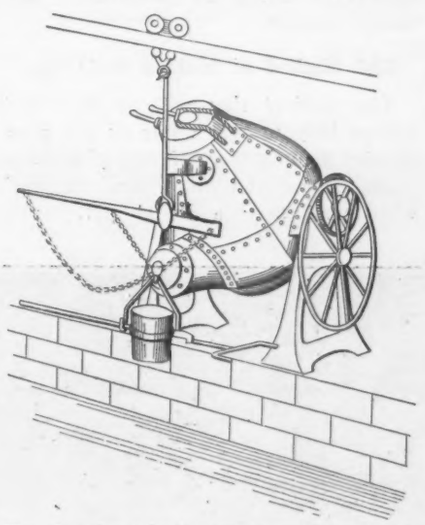


FIG. 3—LADLE IN POSITION IN FRONT OF A SCHWARTZ MELTING FURNACE

above the floor level about two feet. Except when daubing or cleaning the ladles there is no need of taking down the device at any time. The safety clutch F, shown on the shank in Figs. 1 and 2, is provided to prevent the tipping of the ladle while it is being conveyed to the floors.

Before we adopted this device we required four men to handle our metal, melting as high as 20,000 pounds daily. Now we only have two men and they find the work comparatively easy.

Bar D is 54 inches long and the distance between chains A and B on the bar is 24 inches, and A and C, 26 inches.

DETROIT FOUNDRYMEN ORGANIZE.

The Detroit Foundrymen's Association was recently organized at Detroit,

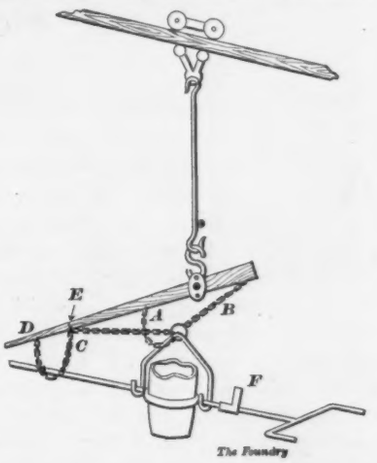


FIG. 2—LADLE IN ELEVATED POSITION

with an initial membership of 50. The moving spirits in its formation consisted largely of members of the American Foundrymen's Association. Officers have been elected as follows: W. M. Corse, Detroit Lubricating Co., president; J. J. Wilson, Cadillac Motor Car Co., vice president; A. P. Henry, Standard Pattern Works, secretary; A. H. Waterfall, Russel Wheel & Foundry Co., treasurer. In addition to the president and vice president the executive committee includes Jas. F. Kieghtly, Great Lakes Engineering Works; Thomas F. Meek, Detroit Steel Castings Co., and W. F. Putnam, Detroit Testing Laboratory.

CHILLED MOLD BOARDS.

BY W. J. KEEP

Question:—We produce a large number of chilled mold boards for plows and we are able to get every quality necessary but that of strength. What we wish to know is whether the use of aluminum will increase the strength of castings. We have used ferro-manganese in the ladle, and we use Nos. 3, 4 and 5 Northern charcoal iron in our mixture.

Answer:—Aluminum will do you no good, it merely softens the iron and reduces the chill. I would suggest that you change the brand of iron and use other grades until you secure the strength that you desire. If you can procure them, would suggest that you use old car wheels for about one-third of your mixture. By trying various mixtures you can secure a hard tough chill as well as a strong gray iron backing.

CASTING PIPE IN PERMANENT MOLDS*

Continuous Process of Making Soil, Water and Gas Pipe at the Rate of 240 Sections Per Hour

BY EDGAR ALAN CUSTER

AT THE PLANT of the Tacony Iron Co., Philadelphia, soil, water and gas pipe are cast in permanent cast iron molds, which the hottest iron attainable from the cupola does not destroy. Cast iron pipe is produced in which the supposed evils of unequal heating and cooling not only do not appear, but do not exist. A machine, whereby the casting operations can be carried on continuously, completes the labor saving equipment of this installation.

History of Permanent Molds.

So-called permanent molds are not new. For many years small iron castings have been successfully made in iron molds, and this without great detriment to either the casting or the mold. These castings, however, were invariably very small and were chilled to extreme hardness. Fortunately, it was not necessary to machine them. This limited the use of such molds very materially. Some years ago the Latrobe Steel Co. cast car couplers in iron molds. Within a few months, an article has been published, describing a successful method of making brake shoes in this manner. These shoes weighed about 20 pounds each, and with the exception of steel ingots and car couplers were the heaviest castings made in iron molds. So far as can be learned, this is about the extent of the art. It has been the dream of every foundryman whose trade requires a large number of duplicate castings, to make these castings in molds that would not only survive the process, but would also produce castings that would be marketable and easily machined.

Old Method of Making Soil Pipe.

The method that will be described relates only to soil, water or gas pipe. In the manufacture of soil pipe, iron flasks, cope and drag, are rammed with sand over a metal pattern; a green sand core is introduced, and the cope and drag are clamped together. The pipe is then poured, with the pipe in a horizontal position, and after cooling, the pipe is removed from the flask and carried to the end of the floor where the cores are removed. Then it is carried to the cleaning room where the sand is rattled off, the gates and fins are removed, and after inspection it is ready for shipment. Altogether the pipe has to be handled ten times. In this process the loss is very great. So much depends upon the condition of the sand; it may be too wet or too dry; the molder may ram carelessly, or may pour his iron negligently so that the foundry loss often reaches 12 to 15 per cent. In summer weather the output is decreased 25 to 40 per cent, due to the inability of the workmen to endure the exacting and exhausting labor. Only one heat a day can be poured in any season. In fact, with very few improvements, and these re-

*Presented at the March Meeting of the Franklin Institute.

FIG. 1—CONTINUOUS PIPE CASTING MACHINE CARRYING 30 PERMANENT MOLDS

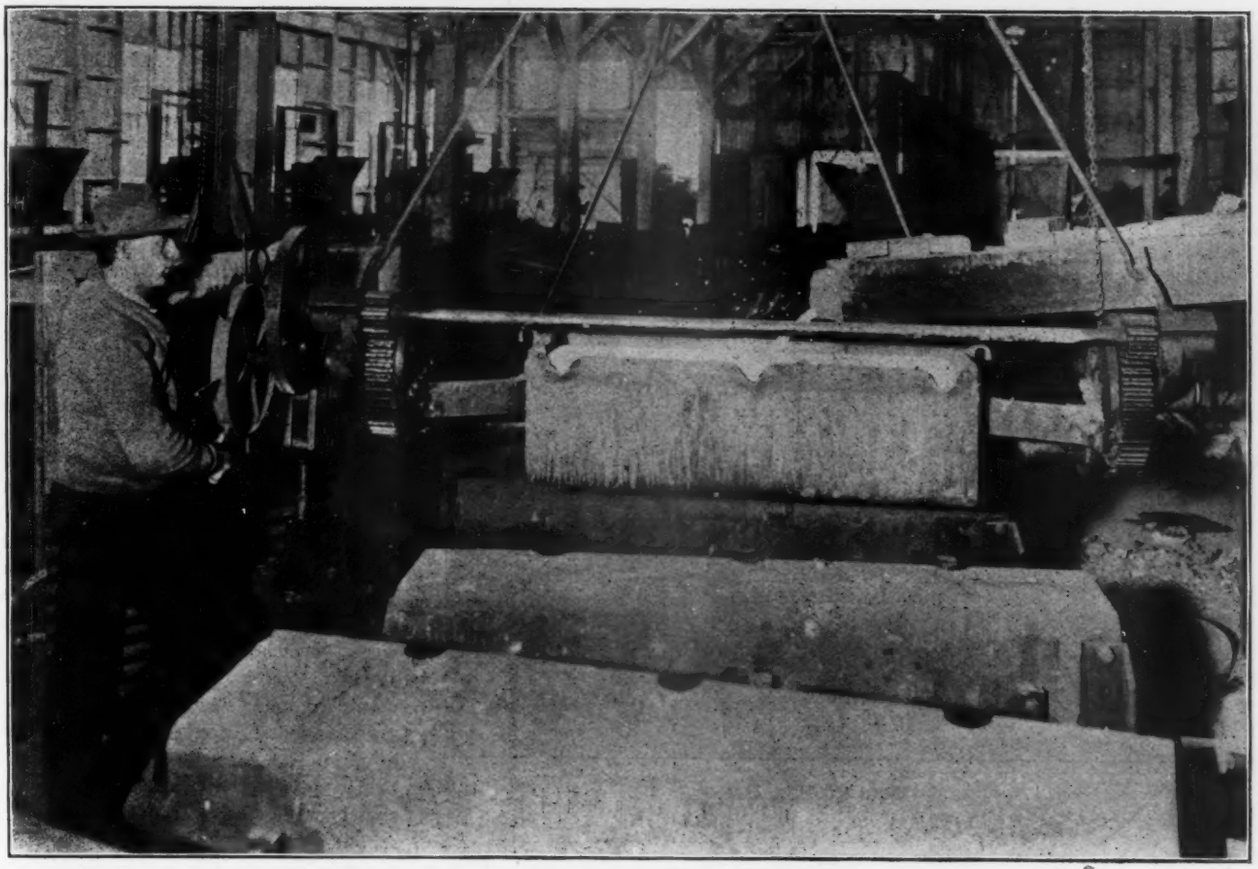


FIG. 2—POURING LADLE WITH THREE LIPS, FILLED DIRECT FROM THE CUPOLA SPOUT

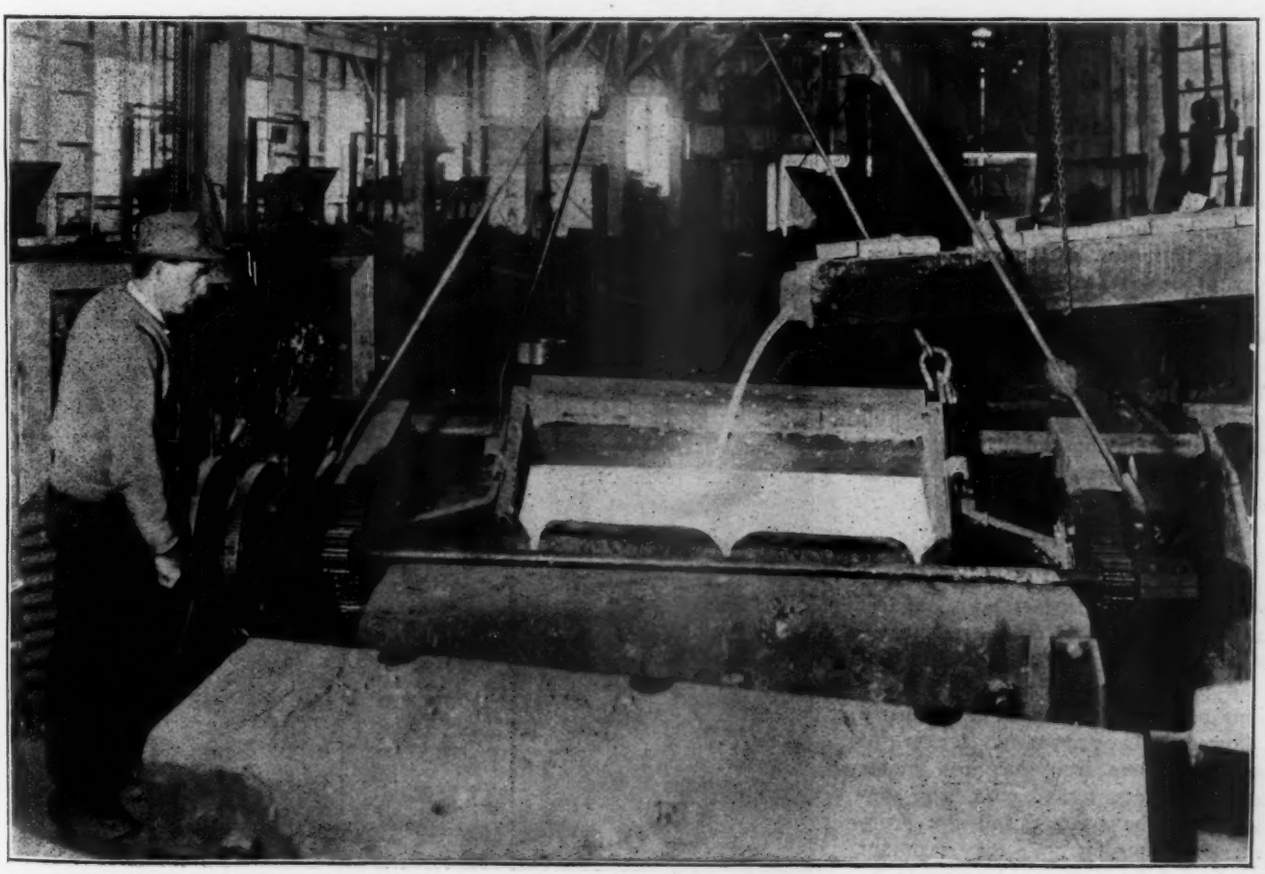


FIG. 3—LADLE IN POURING POSITION, CASTING METAL INTO THE MOLD THROUGH THREE GATES

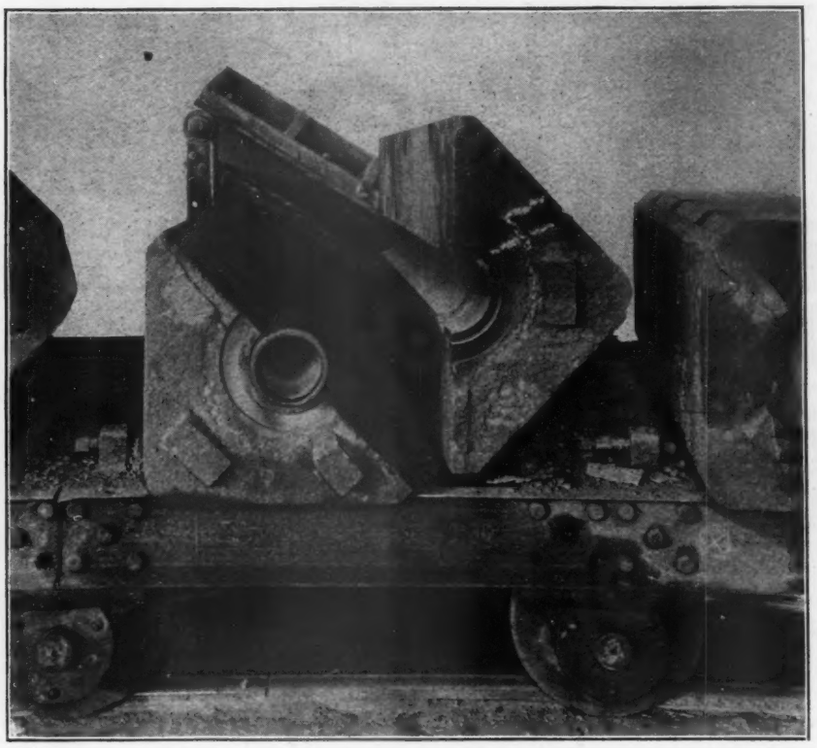


FIG. 4—MOLD CLOSING DEVICE

lating mainly to making cores, we are making soil pipe in precisely the same manner and with just as much labor per pipe as was the practice 50 years ago.

It is true that the workman of today makes more pipe in one day than his grandfather did, but this is due more to the fact that the present day workman is working piece work and has become infinitely more skilled in saving the seconds of time for each particular operation and avoiding the useless motions in performing them. Any process that would save the use of sand for the mold and would produce pipe that could be easily cut would of necessity be very desirable. If in addition it would obviate cleaning and chipping and could be run continuously night and day, it would very nearly meet the conditions of an ideal business.

Early Experiments.

When experiments to discover and perfect such a process were undertaken, the first mold made was closely modeled from the flasks in use in the sand process. In fact, all the traditions of foundry practice were closely followed. The apparent danger of pouring molten iron into iron molds encasing a damp sand core, was considered to be serious, and the problem of disposing of the resultant gases was thought would prove to be a great one. Again, the pipes were less than ¼-inch thick, and it was necessary to pour the iron very quickly. So far as was known, no one had successfully poured a complete pipe in an iron mold, and such attempts that had been made had destroyed the mold very quickly. A mold 6 feet long would be permanently warped in a short time, hence it is not surprising that the experiments were approached with considerable trepidation.

First Permanent Mold.

The first mold made consisted of a cope and drag, each 6 feet long, 10 inches wide and 6 inches thick, with gates cut into the drag. This mold was cast of very soft iron and the pipe shape bored out. The pouring holes were tapered so that when the cope was removed the iron in them could be easily knocked out. In order to avoid as far as possible all traces of moisture, the mold was heated to 500 degrees Fahr., an ordinary green sand core was inserted and four men poured molten iron into the gates. These men wore goggles and were swathed completely in wet cloths. We did not then know what would happen. As it turned out nothing happened, not even a semblance of pipe, the gates were too small. A short session with a hammer and chisel made them larger and on the second attempt a complete pipe was poured. It was not a remarkable pipe except for its defects. It was streaked with cold shot, the top was filled with flat spots where the gases had been trapped and it was as hard as

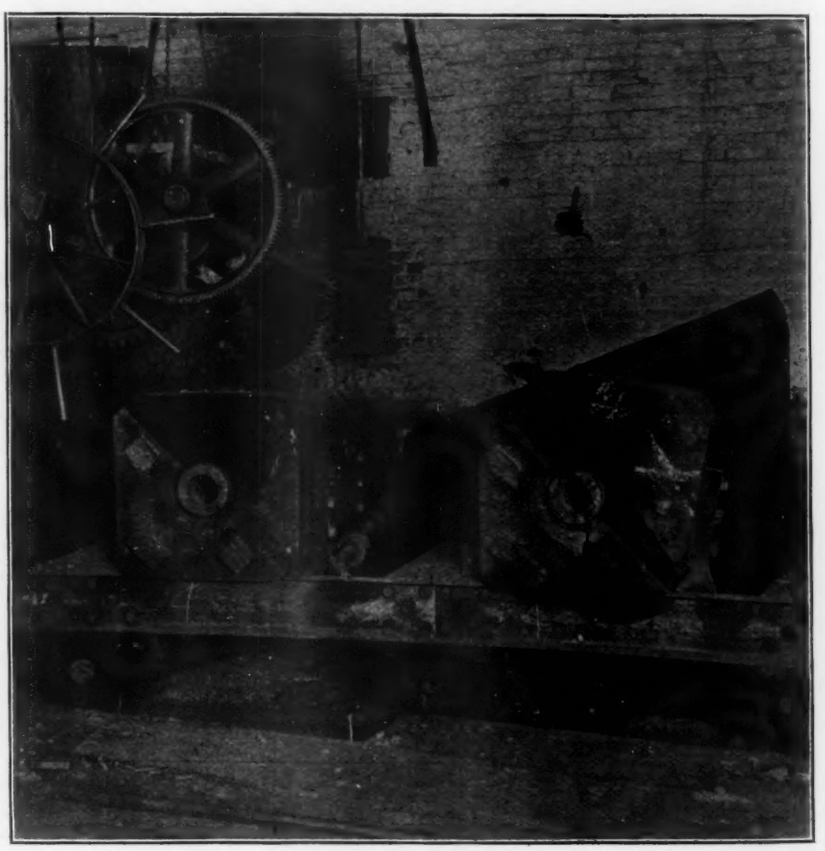


FIG. 5—MOLD OPENING DEVICE

flint. After an infinite number of experiments the mold now in use was evolved. A complete description of this mold as it appears on the machine will be given later. After 50 or 60 pipes had been cast in this mold, it became badly cracked around the gates and as the process of casting was continued these cracks extended into the barrel of the mold. This we attempted to obviate by casting into a new mold very thin strips of mica, extending throughout the length of the mold and placed radially at intervals around the barrel or mold cavity. The cracks we found in this mold would start as before but would stop when the mica was reached. A good illustration of this effect is shown by the fact that a small hole drilled at the extremity of a crack in a sheet of plate glass, immediately stops the further extension of the fracture. In time, the whole face of the mold would show a collection of fine cracks, most of which could only be seen with a magnifying glass. They rarely ever were more than 1/16-inch deep.

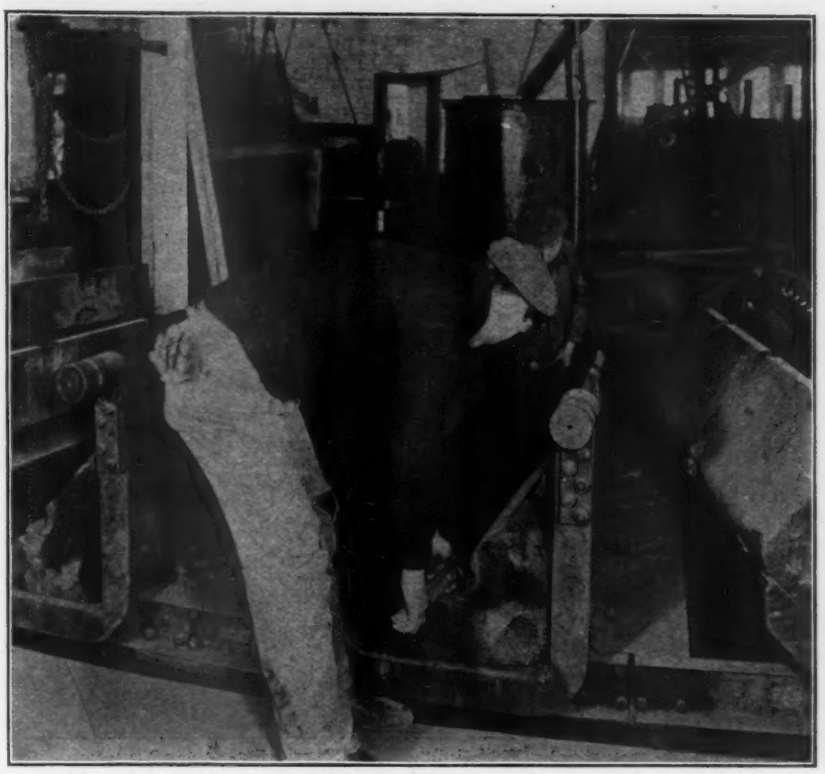


FIG. 6—SETTING THE CORES

After probably 200 pipes had been cast the surface of the mold in contact with the molten iron resembled an extremely hard graphite. It was dull black in color but did not scale or shell off. In order to thoroughly test the mold, the ends were stopped up with sand and the entire barrel, without a core, was filled with molten iron. This was done 30 or 40 times without any appreciable distortion of the outline. The only care exercised was to take the casting out before heavy shrinkage set in. In order to still further test it, the mold was heated to a temperature of about 1,100 degrees Fahr. in a furnace, but it was found impossible to produce pipe under these conditions. The molten iron danced in the mold like water on a hot griddle and the resultant pipe was a collection of closely knit globules. It was found that the safe casting heat of the mold was about 700 degrees Fahr., but that in practical operations 250 degrees Fahr. to 400 degrees Fahr. was the highest heat the molds reached. The actual time in which metal set was carefully noted and the behavior of the cast metal at extremely high temperatures was observed.

FIG. 7—CORE MAKING MACHINE

Experiments with Various Grades of Iron.

Irons high and low in silicon, sulphur, carbon and phosphorus were cast a great many times and copious notes were taken in each case. A small chemical laboratory was established for this work. In all over 4,600 pipes were cast in a 4-inch pipe mold, 2,700 in a 2-inch mold, and over 1,100 in a 6-inch mold. Not one of these molds shows any signs of deterioration over and above the first cracking as described before; in fact, they are in a far better condition than at the start. Each one has been purposely abused and submitted to treatment that never occurs in practice. A straight-edge laid in the barrel today shows the surface to be perfectly straight and the 4,600 pipes show the original marks of the boring out tool.

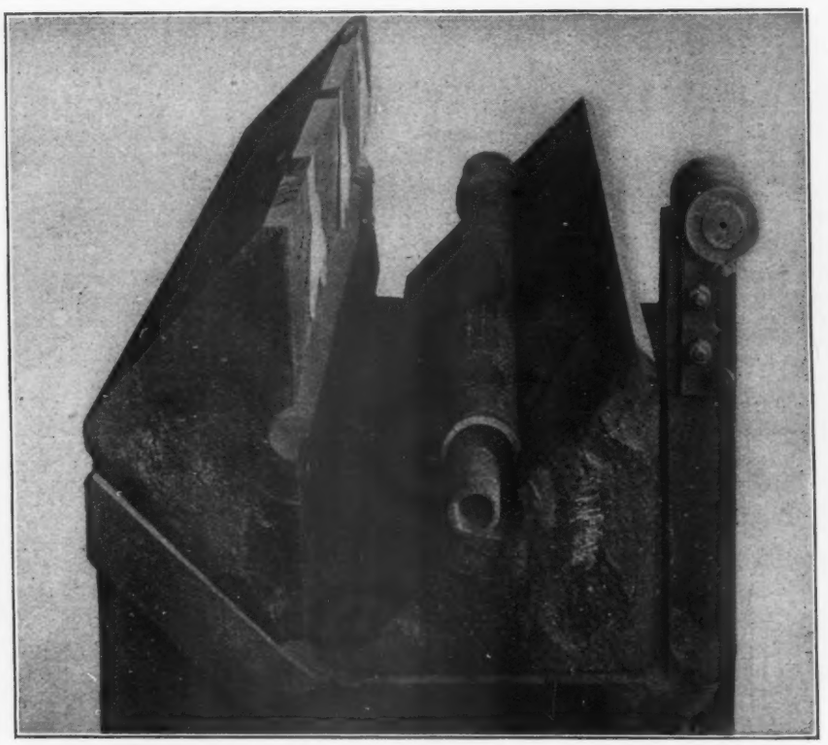


FIG. 8—MOLD OPENED SHOWING PIPE IN PLACE WITH GATES KNOCKED OFF

Silicon and Sulphur Content of Metal.

It was found that an iron running from 2.00 to 2.25 per cent silicon and high in carbon, produced the greatest number of perfect pipes, and when cast iron of this silicon had a comparatively low sulphur content, the result was still better. Further experiments showed that powdered ferro-manganese when added to the molten iron, immediately combined with the sulphur as a manganese sulphide, and rose to the top of the liquid mass as a slag. An excess of manganese, however, produced a hardening effect, as it formed with the carbon, a carbide which in itself is an extremely hard substance. These features made it possible to use a high sulphur cast iron, providing its other contents approximated the figures given above.

Shaking Out the Castings.

It was then noted that pipes that remained in the mold until a dull red heat was reached, were very hard and in most cases were too hard to cut. When they were taken out at a bright yellow heat and allowed to cool normally they were perfect in texture. It was further noticed that when the dull red pipes were piled with the very hot bright yellow pipes, an annealing process was set up that brought the iron in the dull red pipes into a workable condition. This feature of temperature was the subject of a long and patient investigation and the causes leading thereto may be now briefly stated.

Pure iron possesses no fluidity or the property of low shrinkage, nor does it possess varying degrees of hardness. It is obvious then that the characteristics of cast iron, which possesses these qualities in a high degree, are due to the presence of impurities such as carbon, silicon, phosphorus, etc. Carbon is the main element and exists in cast iron as combined and free carbon. The amount of free carbon, which is the principal softener of cast iron, depends principally upon the rate of cooling. If molten iron high in carbon be cooled slowly, the free carbon separates out in the form of graphitic carbon. If this molten iron be suddenly cooled, the carbon is caught before it has time to separate and is held in an atomic condition by the enormous pressure of the surrounding iron. Therefore, the fracture of a pig of iron is generally an index of the rate at which it is cooled. If the suddenly cooled iron be remelted and slowly cooled, it will assume all the characteristics of soft iron. The graphitic carbon will become plainly separated and large crystals will be formed. It may be stated that cast iron in a molten state is a solution of carbon and iron and the mass is homogeneous.

Effect of Silicon.

Silicon in itself confers no benefit on cast iron. It is only its influence on the carbon contents that produces beneficial results. On the other hand, an excess of silicon renders cast iron absolutely unfit for use, making it very hard and brittle. A small quantity through its action on the carbon, reduces shrinkage, increases strength and increases fluidity. Given then cast iron comparatively high in carbon with the proper amount of silicon, the ideal conditions are obtained.

The uses of phosphorus and manganese are too well known to require discussion and play no part in this method except as correctives.

Keeping these facts in mind it may be stated that an ordinary foundry iron very nearly fulfills these conditions, with the exception of sulphur. Molten cast iron is therefore a solution of carbon in iron with the addition of silicon, phosphorus, sulphur and manganese, all forming a homogeneous fluid mass. Now, if this mass be suddenly cooled, it is still homogeneous, the different elements not having time to segregate. If the cooling be continued at the same rapid rate until a temperature of about 1,600 degrees Fahr. is reached the iron be-

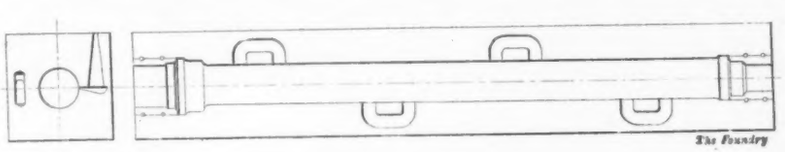


FIG. 9—THE FIRST MOLD

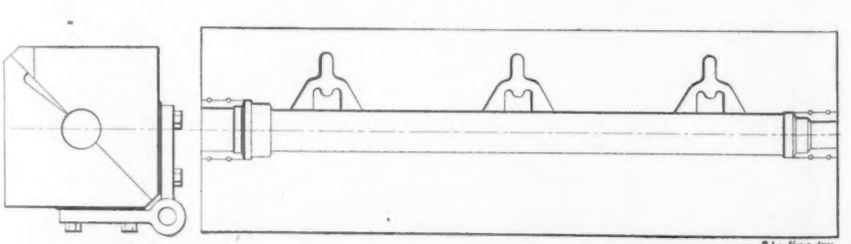


FIG. 10—THE MOLD NOW IN USE

comes very hard and brittle. But if this sudden cooling is carried out only until the iron is set, and is then removed from the cooling influences, thus allowing the iron to lose its heat normally, the result is a structure whose fracture shows a very fine close grain. It is tough, since all its particles are thoroughly interlaced, and it is strong because very nearly all the carbon is held in the combined state. In other words it is homogeneous. Now, let us try to make this vital point plainer.

Rate of Cooling.

In a casting, such as a thin pipe, when cast in an ordinary sand mold, it requires about one minute to cool from the temperature of molten iron to the point at which the metal is set. It is in this period that the detrimental effects as shown in cold cast iron are produced. Phosphorus, sulphur and carbon segregate, and graphitic carbon is formed. Bear in mind that in this period the iron is in a liquid state with all its elements free to move. We may call this the evil period. Once the casting is set, all segregation ceases, and the remaining carbon begins its beneficent work. As the iron loses its heat at a normal rate, annealing and carbide carbon are formed, both of which improve the quality of the metal. Consequently we can call this the beneficent period. Now if we suddenly shoot the molten iron into an iron mold it sets very quickly and the evil period is reduced in time from 60 seconds to 2 seconds—so short a time, in fact, that all the impurities are held in the position they occupied in the molten mass. The evils of sulphur and phosphorus are reduced to a minimum since they are in practically an atomic condition and are distributed evenly throughout the casting; and since no graphitic carbon is formed, all the carbon exists as combined carbon, with a corresponding increase in its power for improvement. If the casting, after it has passed the evil period, is removed from the cooling influence, in this case the iron mold, and allowed to cool normally, the ideal conditions are obtained.

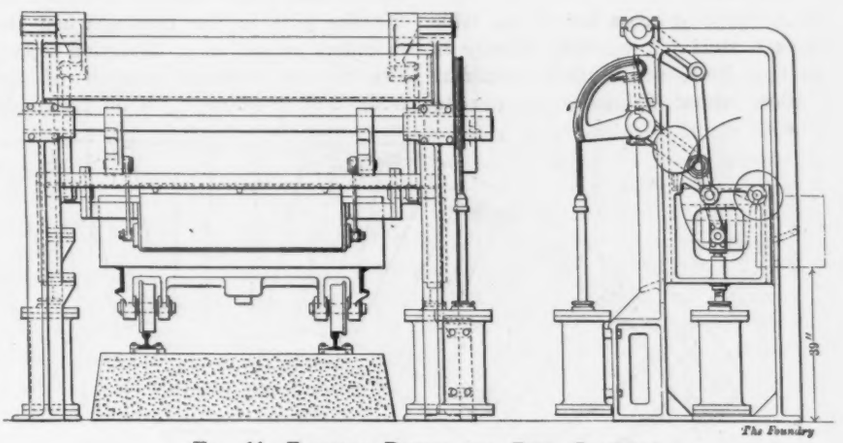


FIG. 11—POURING DEVICE FOR PIPE CASTINGS

Chilling cast iron to the point of extreme hardness is purely a mechanical process and the point to which the process of sudden cooling can be carried can be determined to an absolute certainty. It is simply a question of time. The data collected show that a 2-inch pipe can be removed 2 seconds after pouring and should not remain in the mold more than 6 seconds. A 6-inch pipe can be removed in 6 seconds after pouring and should not remain more than 12 seconds. This time depends upon the thickness of the pipe walls. Very thin pipe would require not only a shorter time in the mold, but should be cast of iron higher in silicon. The reason for this is that silicon by its action on the carbon, keeps the iron in a fluid state longer than normal. Every foundryman knows there are irons in which it is impossible to produce a chill, and there are others in which it is impossible to prevent it. The same limitations apply to making pipe as to the making of other iron products. A suitable iron must be provided if the very best results are to be obtained. This statement applies to any branch of the foundry business and is not set out as a new discovery. What is claimed and demonstrated is, that a poor iron is improved and rendered suitable for the work in hand.

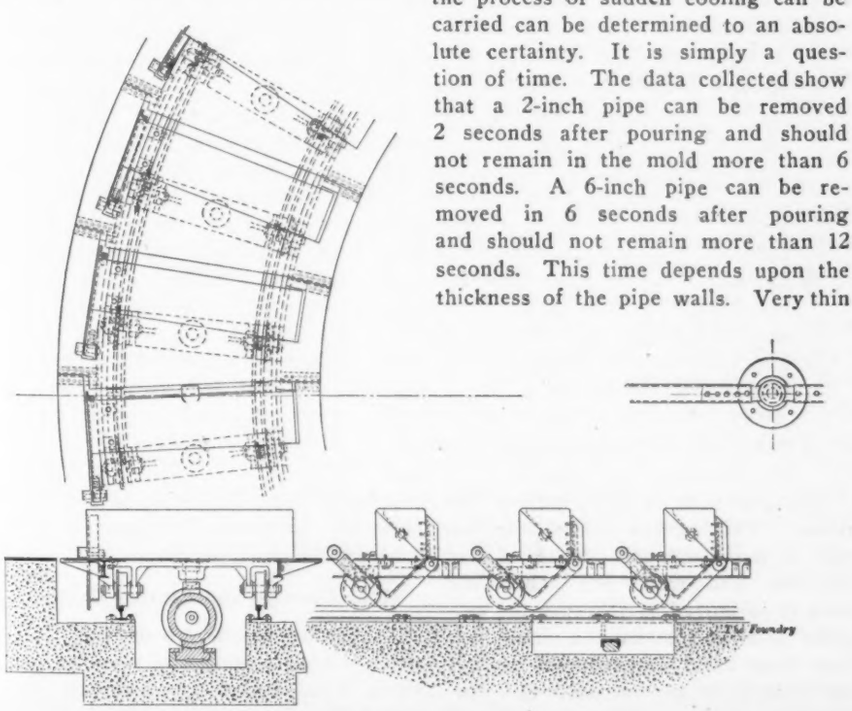


FIG. 12—PART PLAN AND FOUNDATION OF PIPE CASTING MACHINE

Continuous Casting Machine.

With the data obtained the work of designing a machine that would operate continuously was begun. The experiments had shown that when pipes were cast in a mold every 8 minutes, the temperature of the mold never rose above 450 degrees Fahr., even if the operation were continued for hours. If pipes were poured every 2 minutes, the temperature of the mold rose rapidly, and at 900 degrees Fahr. it began to warp. In order to follow the best conditions and avoid the worst, this apparatus was designed.

Construction of the Table.

The machine, Fig. 1, consists of an annular table or ring, approximately 40 feet outside diameter, carrying 30 molds, arranged at equal intervals thereon. The table is constructed of two concentric rings of channel beams, connected with 30 cross pieces or trucks, each of which has two wheels having roller bearing axles. These wheels are arranged to run on concentric circular tracks set in concrete

foundations. The tracks are arranged as if on the surface of a cone and by this means is created a tendency of the table to resist any movement other than rotating about its center. Either outer or inner track may be the higher, as the effect is the same in either case.

Each truck or cross bar of the table carries a steel pin working loosely in a vertical hole, and of such length as to allow about 2 inches of pin to project below bottom line of truck, but admitting of being pushed up until flush with bottom of truck.

Under the table or ring, at two diametrically opposite points, are arranged two hydraulic cylinders which slide in ways similar to a planing table, the pistons within the cylinders being held stationary and the cylinder moved back and forth by the operation of a four-way valve controlling the admission of water, alternately to each end of the cylinders. The stroke of the cylinders is of such length as to be slightly more than the spacing of molds carried by the table and projecting from the top of cylinder is an inclined plane surface designed to lift the pins in the trucks, when the cylinders move in a direction opposite to the required motion of the table, and to allow a pin on each side to fall, after the inclined surface has passed. This occurs at or near the end of the backward stroke of the cylinders, and when the controlling valve is so moved as to cause the cylinders to move forward, the pins which have been lifted and allowed to fall are brought in contact with the projections on the cylinders and hence the table is carried forward by the motion of the cylinders, a distance equal to the spacing of the molds, and the cylinders are ready for another return or back stroke to engage the next pins, thus intermittently moving the table ahead one space, at each cycle of the cylinders.

The center of the table is left open for the location of hydraulic pumps, operating valve reservoirs, etc., required in imparting motion to the table. This table makes one complete revolution every 7½ minutes and consequently produces 30 pipes in that time or 240 pipes per hour.

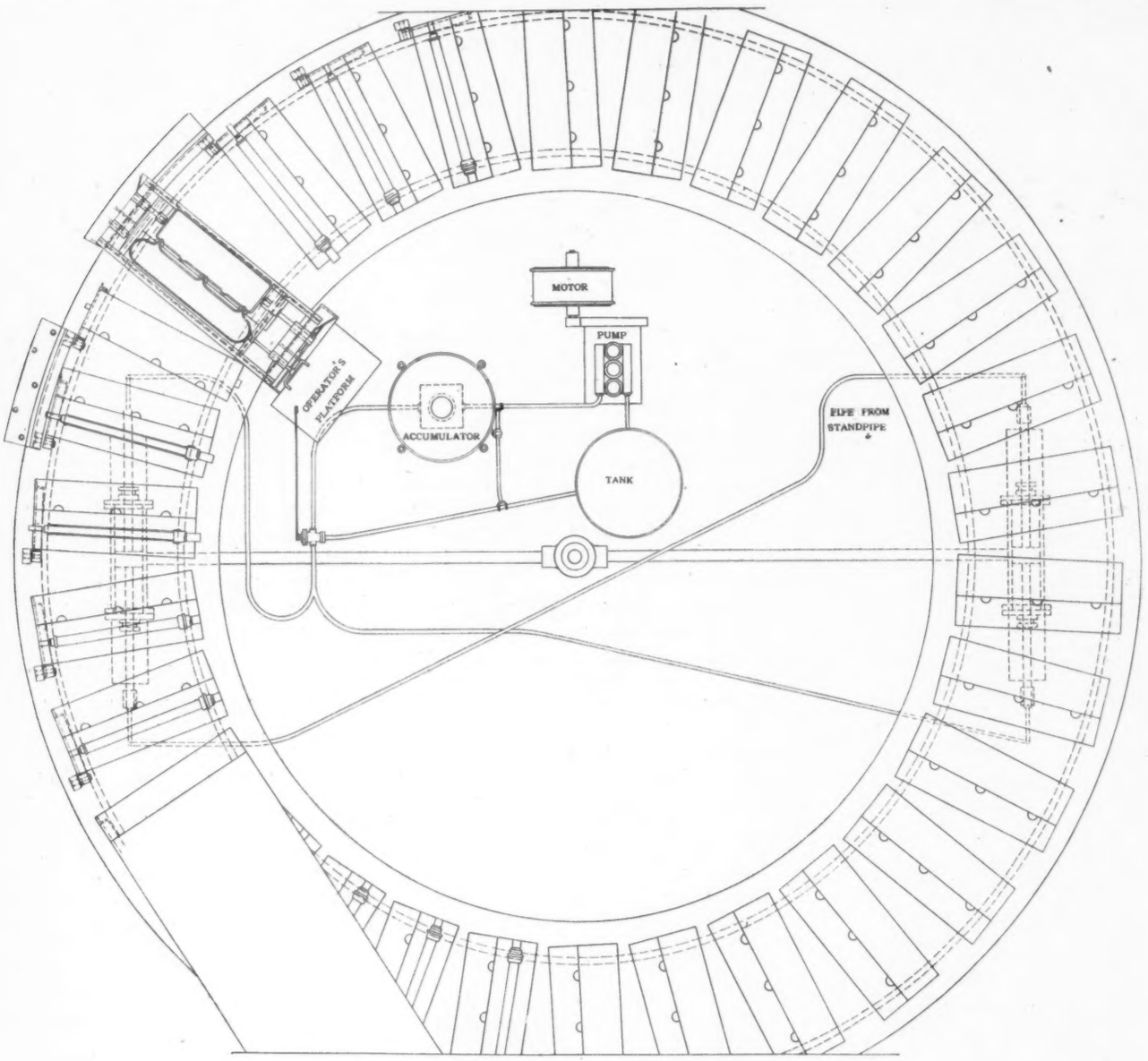


FIG. 13—TABLE PLAN, PIPE CASTING MACHINE

Mold Opening and Closing Device.

At certain points about the table are arranged closing and opening devices, Figs. 4 and 5, which are designed to close the mold, or bring the cope side down to its place on

the drag side, without shock, after the cores are set in place, and to open the mold or lift the cope after the pipe has been poured.

Between the closing device and the opening device is located a pouring device, Figs. 2 and 3, to receive the molten metal from the cupola and pour it into the molds.

Description of the Molds.

Each mold consists of a rectangular block of cast iron, approximately 18 inches wide and 18 inches high, by 6 feet long, parted on a diagonal line across the corners, and provided with hinges at the lower edge of the parting so as to allow the upper portion or cope to be swung up and back from the lower portion or drag. These molds weigh about 6,500 pounds complete.

At the center of the mold is the cavity into which the metal is to be poured, to form the pipe. Thus one-half of the pipe is formed in the upper and one-half in the lower portion of the mold.

The Gates.

Gates are cut in the face portion of the lower part or drag of such size and shape as to receive the molten metal from the ladle and guide it into the mold. Three such gates are used, each dividing into two portions and so entering the cavity of the mold at six points.

These gates are so shaped as to receive the shock of the falling stream of molten metal at a point outside of the mold cavity, and convey it into the mold quickly but gently so that the core is not damaged by a rush of molten metal against it.

At the highest point of the barrel of the mold a small groove is cut, extending throughout the entire length of the barrel. This groove, which is quite small, being only ⅛-inch wide and deep, is intended to receive any gases or air which may be trapped in the mold, and so avoid the formation of flat spots at the top of the pipe. The resultant ridge not being prominent is not an objection but rather adds to the strength of the structure.

On one end of each mold is carried an arm rigidly attached to the upper or movable half. This arm extends under the mold and is of such form that when the mold is open, it forms a rest for the movable half, holding it in such position as to allow of any work such as getting cores, removing finished pipes, cleaning, etc. On the end of this arm is a steel roller which is caused to travel down an inclined plane by the rotation of the table carrying the mold. This inclined plane is arranged to receive the roller at its higher position when the mold is open, and to guide it smoothly to its lower position, by this means closing the mold without shock or jar to disturb the core. This inclined plane constitutes the closing device.

Core Arbor.

Each end of the mold is provided with rings or bushings which are used to support the core arbor in a precisely central position in the cavity of the mold, so that the pipe when finished shall have uniform thickness of metal at every point.

The core arbor consists of a cast iron hollow cylinder somewhat longer than the pipe to be cast and about ¾-inch less in diameter than the inside diameter of the pipe. It is perforated throughout most of its length, by small holes to allow any gases formed by contact with the molten metal to pass into the arbor and so have free vent to the air through the ends of same. Each end of the arbor is accurately machined to fit the rings or bushings in the ends of the molds.

Making the Core.

The core is made by placing the core arbor in the core machine, which consists of a support for the ends of the arbor, semi-circular in form, and of a diameter to fit the arbor ends; a shaking screen arranged to sift sand, and a guide to drop it upon the arbor, and a knife, so shaped as to form the sand to the outline of the inside of the pipe.

The core arbor after being wet thoroughly is placed in the end supports, and rotated by a crank-shaped piece of iron held loosely in one end by an operator. At the same time another operator shakes a sieve suspended over the arbor and previously filled with sand, tempered to the proper degree with water. This sieved sand is caused to fall directly upon the wet, rotating arbor and clings to it. The surplus sand is scraped away by a steel knife held at the proper distance from the arbor to make the finished core of the diameter and shape required. When sufficient sand is on the arbor to make a full and complete core (which requires about 5 seconds), the core is lifted from its supports, and is ready for use. No further treatment of any kind is needed, and the core is placed in position in the mold which is then caused to pass the closing device, bringing the upper portion down in place, and the mold is ready to receive the metal.

A ladle is provided to receive the metal as it flows from the cupola. This ladle is arranged so that it can take a position high enough to allow the molds to pass freely under it, or it can be lowered into a position between two adjacent molds so that the pouring spouts or lips of the ladle are very close to the pouring holes of the mold.

As the table rotates and brings a mold, which has passed the closing device, into pouring position, the ladle automatically drops into this latter position with the lips close to the pouring holes. The ladle is then tilted to pour by the operator, but in tilting it rotates around a center line which passes through the pouring lips, and hence the points of pouring do not move; and the streams of metal are guided directly into the pouring holes through the various gates, into the mold, and fill it completely, compressing any air or gas which may be trapped into the groove provided at the highest point for that purpose. If no gases are trapped, which, strange as it may seem, is usually the case, this groove is also filled with metal and forms a slight rib running the length of the pipe.

When the pouring operation is complete and operator tilts the ladle back, it automatically rises to its higher position, so that the next mold may pass under it and assume the pouring position.

The mold, being now filled with metal, is held long enough to allow the metal to set enough to hold together, and then opened by passing the opening device, which is just the reverse of the closing device; the roller on the end of arm or mold, being guided up an inclined plane, thereby lifting the upper half or cope side and swinging it away from the lower or drag side.

The pipe, which is still a bright orange color, is lifted from the mold and placed, after removal of gates, with those previously cast, in piles, to cool slowly, when the core arbor is withdrawn and returned to core machines to be used again.

After removal of the finished pipe from the mold, the loose sand which falls from core during the handling of the pipe, and any other dirt, loose gates, etc., which may be left in the mold, are swept out by air blasts or hand brushes and the mold is ready for another core and another filling with metal.

The method of pouring is very important; in fact, the success of the whole operation hinges very closely upon properly carrying out this scheme.

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Advance of the Molding Machine

That the foundrymen are taking advantage of the present lull to improve their plants by the installation of labor-saving appliances is indicated by the continued heavy demand for foundry equipment. Builders of molding machines are experiencing little difficulty in introducing their tools into shops where, heretofore, it was contended that the patterns were too intricate to permit of their mounting on molding machines. The recent advancement in molding methods in the stove trade particularly, has been marked. For many years, stove founders have been of the opinion that their delicate faced work, requiring printing-back, could only be successfully produced by the most skillful molders. Honest trials given molding machines in the last 12 months have proven the fallacy of this contention, one shop alone already having no less than 55 in use. In this plant the output per floor has been more than doubled, and the losses, contrasted with previous methods, have been reduced. As a result of this and other successes, stove plate molding methods will undoubtedly undergo a revolutionary change in the next few years. Among the stove founders the molding machine builders have found an almost virgin field and they are taking advantage of present trade conditions and are introducing their tools in many shops. In other branches of the foundry industry there is also apparent a marked realization of the many economies that can be effected by improved molding methods. With lower prices prevailing for castings, the founder will naturally cast about to reduce his costs and the item of molding receives first consideration on account of the labor and expense involved. Steel foundries receiving large tonnages of duplicate work from the railroads can effect great economies by the use of molding machines, and several large orders for tools of the stripping plate type for making bolsters and other large castings have recently been placed. The molding machine is relatively as important to the foundry as the latest improved machine tool is to the machine shop. The cost of mounting patterns can be reduced to the minimum by the use of machines adapted for jobbing work, and this expenditure is insignificant on duplicate work where the first outlay can be spread over a large number of castings. Steel manufacturers have religiously made a practice of improving their plants and equipment during periods of depression, to more successfully compete while prices are low and to be prepared for an increased demand when the reaction occurs. Foundrymen can well afford to pursue this policy, and while operating below normal capacity, experiments can be made that could not be undertaken during periods of activity. Nor are the molding machine makers the only builders of foundry equipment experiencing a relatively heavy demand for their appliances. For handling metal in small shops many overhead trolleys are being installed, and electric travelers are replacing hand-power cranes in many foundries.

Trade Outlook

Notwithstanding the efforts that are being made to control pig iron prices, values have again declined during the last 30 days. No. 2 foundry iron has been sold on a basis below $12, Birmingham, and one northern furnace has shaded $15 for No. 2. This quotation practically represented cost on the present basis at which ore is held, although none has been sold on this schedule by the producers for this year's delivery. Shipments to lower lake ports will be curtailed, as the stock now on hand is sufficient to meet the furnace requirements operating at capacity, until September. Foundry trade conditions have shown only a slight improvement, but jobbing shops report the receipt of more repair work than at any time in the last six months. The railroads, however, continue their curtailment policies and the steel and malleable interests continue to operate far below their normal capacities. The decline in prices is out of proportion with the reduction in metal, consumers seeking not only the benefits of the reduction in iron but other alleged advantages as well. The pattern shops are receiving more work than at any time during the last few months, and this is considered a forerunner of improved foundry trade conditions.

The Toronto Convention

Present indications point to a record-breaking attendance at the foundrymen's convention which will be held in Toronto in June. Manufacturers of foundry equipment are already preparing to make more elaborate exhibits than at Philadelphia, and many new labor-saving devices will receive their initial introduction to the trade at this time. The facilities that will be provided for the exposition will

prove unequalled and the business meetings, which will be held in a separate auditorium, can be carried on without interruption from the noise of operating machinery. It is needless to state that all foundry Canada will be there and true Canadian hospitality will prevail. The provisional program outlined, foreshadows the greatest gathering in the history of the American Foundrymen's Association and allied organizations. Foundrymen, who last year sent their foremen to attend the Philadelphia meeting, are preparing to increase their representation by the addition of several ambitious molders and apprentices. The benefits that can be derived by these operatives at these gatherings are insignificant when compared with the educational advantages afforded. At the business meetings more discussion will be invited and to provide ample time for this feature the number of papers that will be read will not be as great as at previous gatherings. At many of the former meetings, so much time was devoted to lengthy papers that few of the foundrymen were given opportunities of expressing themselves. This experiment will undoubtedly result in the development of discussion along practical lines and the experiences of others will prove of the utmost value to every delegate who makes the trip to the Queen City of the North.

TRADE NOTES.

The recent increase of the capital stock of the E. H. Mumford Co., Philadelphia, manufacturer of molding machines, is to provide for the purchase of the American rights to the patents of the French machine, manufactured by Ph. Bonvillain & E. Ronceray, Paris, France.

The Ralph Molding Device Co. has been incorporated at Buffalo, N. Y., with $100,000 capital to manufacture molding machines. A plant will be built in Buffalo. Malsby Kimball, E. C. Schafer, Clifford E. Branch and B. Kerr, Buffalo, are the directors, and the company's offices are located at 786 Ellicott square for the present.

The Cliche table of Ph. Bonvillain & E. Ronceray, Paris, France, by which metal patterns in perfect match are plated from loose patterns for short run orders on split pattern vibrator machines, squeezers, or on the bench, in from 30 to 90 minutes, is described in a circular issued by the E. H. Mumford Co., Philadelphia.

The Bristol Co., Waterbury, Conn., has passed under the control of Prof. Wm. H. Bristol, whose inventions this company has been manufacturing since it was organized in 1899. Prof. Bristol assumed active charge of the management of the business March 28, and now owns the majority interest. The business, which has been carried on under the personal name of Wm. H. Bristol in New York, has been combined with the Bristol Co. The Bristol Co. was organized in 1889 under the name of Bristol's Mfg. Co., but two years ago, Wm. H. Bristol withdrew from the presidency and since that time has developed electric pyrometers and other recording instruments, which have come into wide use.

FRANK H. CHAMBERLIN

The S. Obermayer Co., Cincinnati, manufacturer of foundry supplies, has opened a warehouse at 1604 North Broadway, St. Louis, with C. M. Barker in charge. Mr. Barker has been a representative of the Obermayer Co. for a number of years, with offices in the Roe building. On account of the ever increasing demand for its products, the company has found it necessary to carry a large stock of foundry facings and supplies to meet the immediate requirements of foundries in and adjacent to St. Louis. The S. Obermayer Co. now has offices and warehouses in the following cities: Cincinnati, Chicago, Pittsburg, Philadelphia, Cleveland, Denver, Kansas City, Milwaukee, Troy, N. Y., and St. Louis.

The Millers' Products Co., Thirty-ninth and Wallace streets, Chicago, is offering to the foundry trade a new core compound called Black Diamond. With this core compound gangway sand can be used in the proportions of 30 to 40 parts of sand to one part of compound. It makes a very strong core that can be handled without breaking, and it is claimed that the cores will not swell, crack, blow nor buckle, that they will not absorb moisture and that they make very little gas or smoke, and leave the castings smooth. The cores remain the same size in baking, and are readily released from the casting. The compound can also be used in facing sand.

PERSONAL.

Alexander E. Outerbridge Jr., of William Sellers & Co., Inc., Philadelphia, has recently returned from the south where he recuperated from a critical illness.

D. Ralph Day, secretary of the Northwestern Malleable Iron Co., Milwaukee, has resigned to accept a position as manager of the Moline, Ill., plant of the Union Iron Co.

Buckner A. Wallingford, junior partner in the pig iron firm of Walter-Wallingford & Co., Cincinnati, has taken charge of the Pittsburg office of that concern.

E. E. Keller, who was connected with Westinghouse interests for more than 20 years, and who for the past 14 years was vice president of the Westinghouse Machine Co., Pittsburg, has severed his connection with the management of that concern.

S. W. Spear has resigned as vice president and general manager of the Elmwood Castings Co., Cincinnati.

Lester C. Riddle, assistant secretary and general sales manager of the West Virginia Malleable Iron Co., Point Pleasant, W. Va., has resigned.

James E. Evans, Chicago city salesman of the S. Obermayer Co., for the past 15 years, has been elected alderman of the 13th ward and recently took his seat in the Chicago city council.

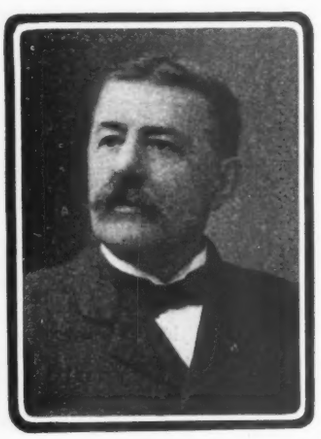
OBITUARY.

Frank H. Chamberlin, president and general manager of the J. D. Smith Foundry Supply Co., Cleveland, died April 10 from meningitis, after three weeks' illness. Mr. Chamberlin was born in Cleveland, July 29, 1870, and graduated from Case School of Applied Science in 1892. His first business connection was with the Variety Iron Works, of which the Cleveland Facing Mill was then a part. After two years, Mr. Chamberlin became proprietor of the Cleveland Facing Mill, which, six years later, was consolidated with the

J. D. Smith Foundry Supply Co., of Cincinnati, whose plant had been destroyed by fire. The new company expanded rapidly and added an engineering department. Large additions were made to the plant during the past two years. Mr. Chamberlin was a member of the chamber of commerce, builders' exchange, University Club and the Phi Kappa Psi fraternity. He leaves a widow and two sons.

A few days after the 10th annual convention of the National Metal Trades Association assembled in New York and, with enthusiasm, re-elected him an honorary member of its administrative council, W. H. Pfahler died at Pasadena, Cal. There, surrounded only by a few of the immediate members of his family, he passed away March 29.

He was born at Columbia, Pa., March 26, 1842, and was educated at the Millersville Normal School, Millersville, Pa. He engaged in the tin



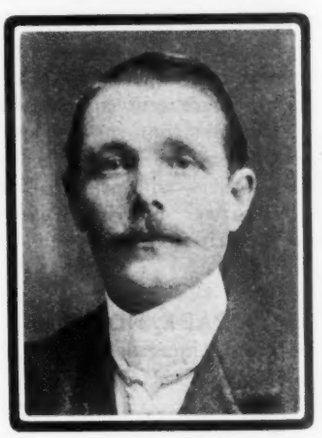
W. H. PFAHLER

and stove business with his father at Columbia and in 1861, at the age of 19 years, enlisted in the 45th regiment of Pennsylvania Volunteers. He served through the war and was mustered out with the title of brevet major. He then opened a hardware store at Columbia under the style of Pfahler & Herr, afterwards purchasing the interest of his partner. He continued in this business until he accepted the position of general manager of the Keeley Stove Co., Royersford, Pa., subsequently removed to Columbia. In 1886 he accepted the position of superintendent of the Abram Cox Stove Co. of Philadelphia, afterward becoming its treasurer, from which position he retired in 1905, but was still a director of the company at the time of his death. In 1906 the Model Heating Co. was formed, to take over the house heating boiler business of the Abram Cox Stove Co., and he was made its treasurer. At the time of his death he was president of that company and also president of the Reading Radiator Co.

He was a member of the Union League of Philadelphia, honorary member of the administrative council of the National Founders' Association, honorary member of the administrative council of the National Metal Trades Association, served on the original executive committee of the National Civic Federation, was a director of the City Trust Co. of Philadelphia and a member of the Loyal Legion. Although not actively identified with the management of the Stove Founders' National Defense Association, Mr. Pfahler was a careful observer of its work, and in that way became deeply interested in the settlement by conciliation of questions arising from the relations of employers and molders. Shortly after the organization of the American Foundrymen's Association at Philadelphia in 1896, he came to the conclusion that the time was ripe for introducing in the general foundry trades the methods which had been adopted by the stove founders in settling labor troubles and seized the opportunity afforded by a meeting of western foundrymen in Cincinnati in October, 1897, to present his views. The proposition was not deemed one which could be taken up by the American Foundrymen's Association, but a new organization was formed to handle labor questions under the name of the National Founders' Association. Of this new organization Mr. Pfahler was the first president, and took a prominent part in its affairs for a number of years. He also assisted in the organization of the National Metal Trades Association, for the purpose of inculcating his ideas in the minds of employers in the machinist trade. He was a close student of economics and a forcible speaker, possessing that personal magnetism which carries conviction. Few men have so impressed their personality on the foundry trade as Mr. Pfahler. He leaves a widow, one daughter and one son, the latter being A. E. Pfahler, treasurer of the Model Heating Co.

A. L. Boughton, secretary of the Standard Sand & Machine Co., Cleveland, died April 12 at his home in that city, aged 37 years. About six weeks ago, Mr. Boughton suffered from a severe attack of pneumonia, which later developed into an abscess of the left lung. He was born in Copeley township, Summit county, Ohio, and in 1901 came to Cleveland, where, together with his brother and his father, he established the Standard Sand & Machine Co. for the manufacture of sand elevating and conveying machinery. Mr. Boughton was well known in the foundry trade, and to his skill is largely due the rapid development of the machinery manufactured by this concern.

The Killing Molding Machine Co., Davenport, Iowa, manufacturer of molding machines, flasks and steel jackets, has sold to E. Killing its stock, patents and book accounts. Mr. Killing recently purchased the plant of the Simplex Washing Machine Co., at West Davenport, and the molding machine works will be removed to that location. The new plant will be known by the firm name of E. Killing's Molding Machine Works.



A. L. BOUGHTON

The G. M. Yost Mfg. Co., manufacturer of vises, Mechanicsburg, Pa., has completed a modern plant at Meadville, Pa., where the main offices of the company are now located, and where all correspondence should be addressed.

MISSISSIPPI VALLEY FOREMEN ORGANIZE.

A local branch of the Associated Foundrymen has been organized by the foundrymen located in Moline, Davenport, and Rock Island, and at the meeting recently held, James F. Webb was elected president and Herman Becker, secretary. The next meeting will be held at the Harper house, Rock Island, and monthly meetings are to be held in the three cities, alternately. Ten foremen have already been enrolled and it is probable that the membership will be increased to 25

FOUNDRY & PATTERN SHOP EQUIPMENT

Pattern Shop Lathe—Portable Oil Burner—Overhead Trolley System—Berkshire Improved Molding Machine—Continuous Tumbling Mill—Skim Gate

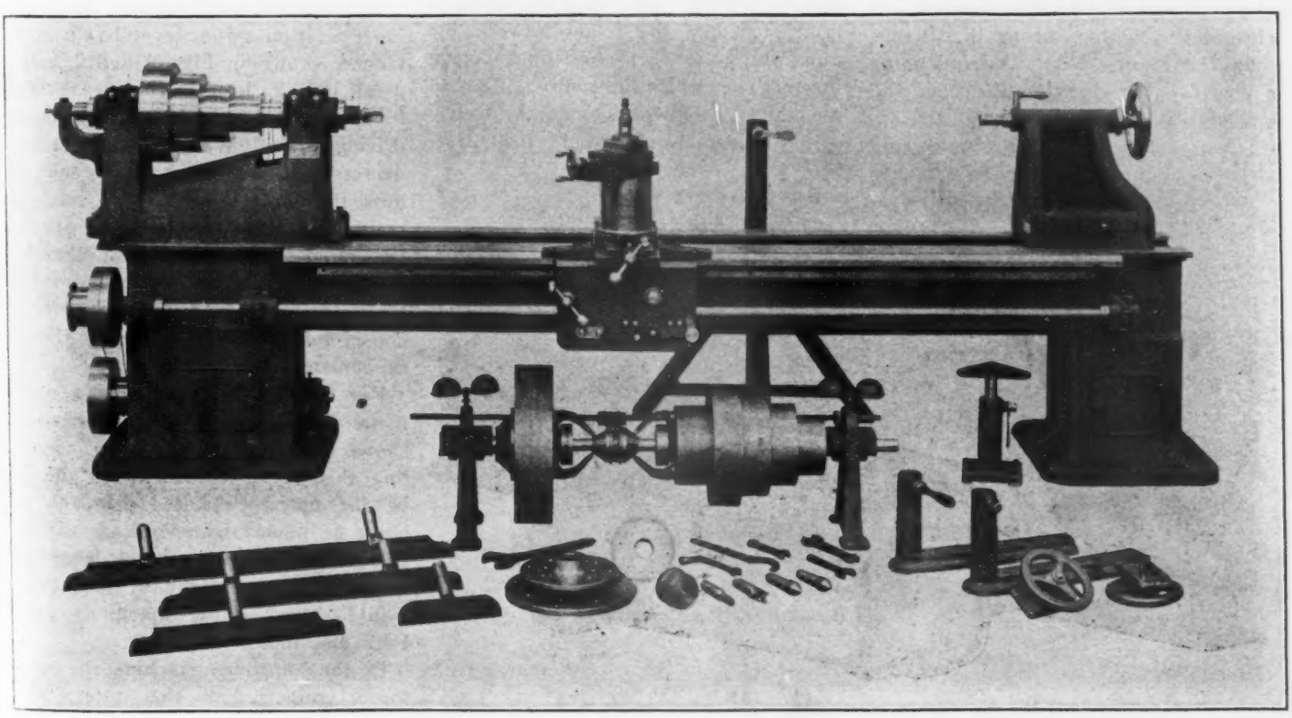
THE patternmakers' lathe shown in the accompanying illustration, built by the American Wood Working Machinery Co., Rochester, N. Y., is designed for rapid operation, and in its construction every effort has been made to maintain the quality of the most modern iron working machine tools. The frame is heavy and rigid, the two cored columns having wide flanges which prevent vibration. The ways on the bed are wide and the slide for the carriage is placed on the side of the bed below the surface and will not interfere with any of the tools resting on the bed. The head block has been built very heavy and carries a strong hollow spindle which operates in side clamping, self oiling boxes. The head block may be swiveled five degrees either way from the center line. The cast iron pulley is machined both inside and outside and has a groove next to the flange on each step to prevent interference and consequent damage to the belt. The spindle has a 7/8-inch hole running through it to facilitate face plate work. An end step or thrust bearing is provided for the spindle, so arranged with bronze thrust washers, set screw and check nut as to rigidly take up any end play. It is interchangeable and can be placed at either end of the head block.

The tail block is the open type to permit the cutting tools to be brought close to the centers without interference. The spindle is bored and reamed for centers having 1½-inch taper in 12 inches. The largest diameter of the hole is 1¼ inches which is the same as the head block and insures a large and rigid center. The carriage can be operated either by hand or power feed in either direction. It has a 22-inch bearing on the front side of the bed, is securely gibbed and has a transverse thrust bearing between the apron and the lower side of the bed. The automatic feeding mechanism for the carriage is self contained in the apron and consists of a train of metal gears driven by a worm and a worm wheel, which are driven by a longitudinal feed shaft. This in turn is driven from a sub-counter-shaft contained inside the base, which is driven by a belt from the head block spindle.

There are two changes of feed, 1/16 and ⅛-inch per revolution of the spindle. This speed can be doubled by reversing the cones on the feed shaft. A cross line screw for moving the turret has a micrometer adjustment. The cross slide is neatly fitted and strongly gibbed to the carriage, and has an extra long traverse for turning duplicate parts. The turret plate is graduated in degrees so that the compound rest can be instantly set to any desired angle. This lathe is built in three sizes, 20-inch, 26-inch and 32-inch swing. For the 20-inch machine, beds are furnished 10 feet long, while for the 26-inch and 32-inch machines, the beds are 12 feet.

THE PORTABLE OIL BURNER IN THE FOUNDRY.

Two convenient applications of the portable oil burner to foundry work are shown in the accompanying illus-



PATTERN SHOP LATHE BUILT BY THE AMERICAN WOOD WORKING MACHINERY CO.

FIG. 1—HAUCK BURNER USED FOR LADLE HEATING

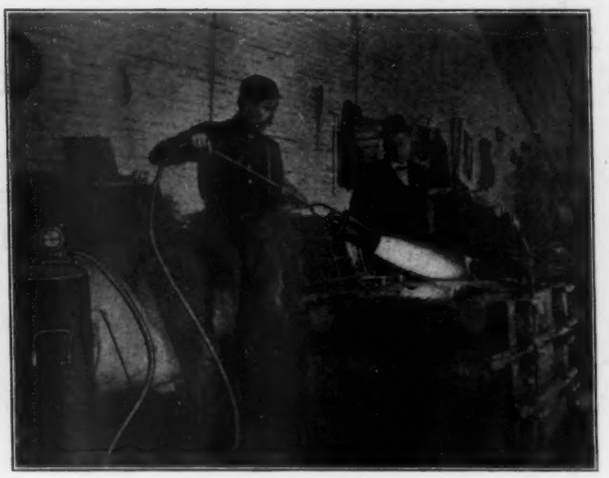
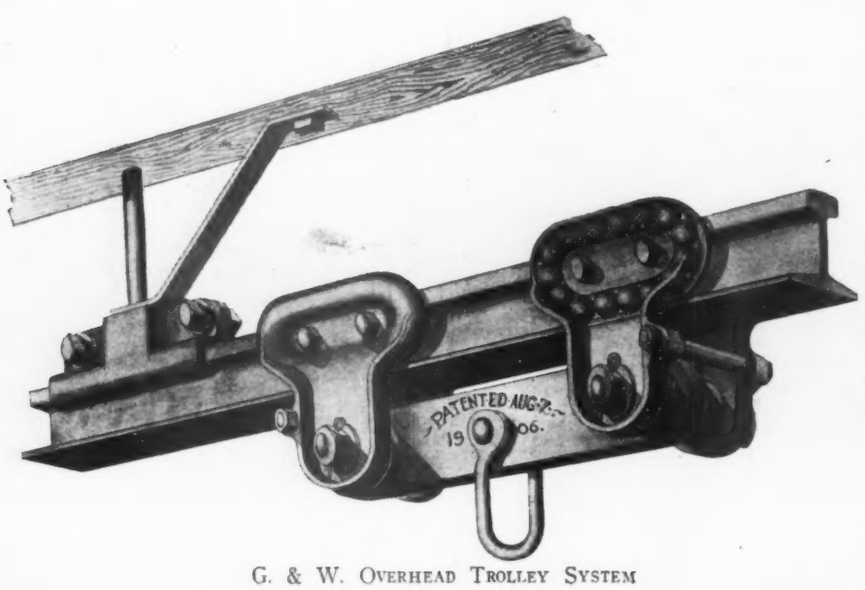


FIG. 2—HAUCK BURNER SKIN-DRYING MOLDS

trations. In Fig. 1 the Hauck burner is employed in ladle heating and in Fig. 2 in skin-drying molds, but it is equally well adapted for brazing, where a high temperature is provided for, as well as for hardening, annealing, bending, expanding, melting the softer metals, heating castings, firing coke in small cupolas and a variety of other purposes. It is also designed for lighting. Either kerosene or fuel oil can be used and the construction of the burner is such as to insure complete combustion, with the obvious results of maximum temperature, no smoke or odor and no waste of oil. The oil is placed in a tank under pressure of from 15 to 100 pounds per square inch. From this a line of tubing conveys the oil to the burner, where it is formed into a heavy gas which burns with a strong blue flame, giving an intense heat. A hand pump is provided for charging the tank and securing air pressure where this is necessary. For skin-drying molds and similar work a high temperature is not required and only a light pressure is sufficient. This burner is made by the Hauck Mfg. Co., 36 Rapelyea street, Brooklyn, N. Y.

A BALL TROLLEY SYSTEM.

An overhead trolley system in which the trolley runs on balls instead of wheels is being introduced to the foundry trade by the patentees, the G. & W. Mfg. Co., 26 Cortlandt street, New York City. Among the advantages enumerated for this system is the ease with which it can be erected, and does not require the drilling of holes, the work consisting merely of securing the lag or machine bolts in the overhead supports and the fitting of the clamps around the bolt head and the head of the rail. By bolting these clamps firmly together, the joints between the rails are given a perfect, non-slipping juncture over which the trolley will travel smoothly. The two sides of the trolley open considerably toward the top, thereby giving room to pass the slight obstruction of the clamps without difficulty, and the same plan is followed with the ordinary wheel trolley, which can be used in place of the ball trolley shown in the illustration. Switches and turntables can be supplied with this system.



G. & W. OVERHEAD TROLLEY SYSTEM

THE IMPROVED BERKSHIRE MOLDING MACHINE.

The operation of the molding machine, built by the Berkshire Mfg. Co., Cleveland, has been simplified and the producing capacity increased by numerous improvements recently made. This machine has been on the market for several years and has given eminent satisfaction both as to output and the class of molds produced.

For starting and stopping the molding operation a foot lever has been attached, shown in Figs. 1 and 2, and in detail in Fig. 3. This replaces the hand lever which engaged a clutch in the driving wheel. When the foot lever is depressed it releases a catch and permits the shaft to make one complete revolution, thereby making one-half the mold. By the use of the foot lever, the operator is not compelled to leave the front of his machine and considerable time is gained by this arrangement.

For lifting the flask pins a pneumatic device has been attached as shown in Fig. 3. The lever controlling this device is thrown to the left by the operator's knee when the machine is placed in operation. In the earlier machines a hand lever was used to release the flask pins which would drop as the machine carried back the flasks.

In the improved machine the vibrator is connected to the pattern plate by an arm and is located in the machine away from the gas jets used

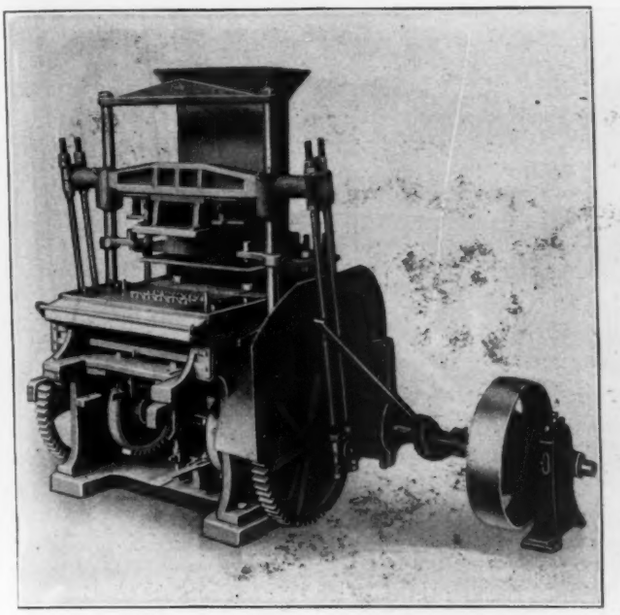


FIG. 1—IMPROVED BERKSHIRE MOLDING MACHINE

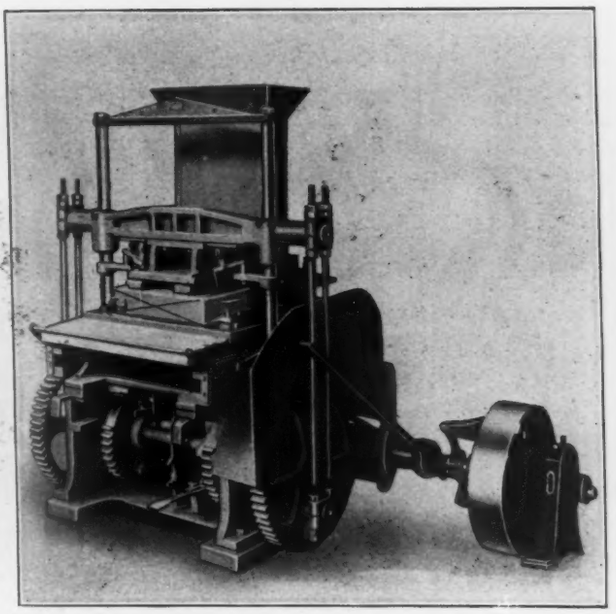


FIG. 2—PATTERN PLATE UNDER SAND HOPPER

for heating the pattern plates. The vibrator also is given an oscillating motion which is more effective than the longitudinal movement heretofore applied. The operation of the vibrator begins when the flask starts under the sand hopper and its period of operation is controlled by a cam on the auxiliary shaft. Increasing the time of the vibrator operation results in jarring down the sand more effectively into all the pockets of the patterns. The vibrator continues to operate until the pattern is lifted from the pattern plate. The time of vibration is regulated by the cam and it can be stopped when the mold just clears the plate or continued until the flask has been raised to its full height. The height of the lift can be varied up to 3 inches. The speed of raising the flask is controlled by a valve so that it can be lifted rapidly or slowly according to the nature of the work. The air cylinder can also be used for drawing the patterns down through a stripping plate if necessary.

Inasmuch as gas jets are used for heating the pattern plate an asbestos apron has been introduced for protecting the operating parts when the pattern plate is underneath the sand hopper as shown in Fig. 1. The curtain which is made of wire cloth and asbestos is carried on a steel roller actuated by a spring similar to that used in a window shade.

Another feature is the positive stop which centers the flask under the ramming head. This effectively prevents the ramming of the sprue out of place. The clutch pulley on the shaft is merely intended as an emergency device to stop the machine. All of the operating parts have been bushed so that wear can be taken up. The method of sand feeding and ramming remains unchanged.

The pin holes of the flasks furnished with the machine are drilled to allow for the expansion of the pattern plate which is heated, as heretofore noted, thus insuring an accurate fit under operating conditions.

A NEW VERTICAL PUMP.

To meet the constantly growing demand for an inexpensive vertical steam pump, of small and moderate size, adaptable to boiler feeding and general service, the Blake & Knowles Steam Pump Works, New York, has just perfected a new design for a vertical, duplex pump, which meets these conditions. It is especially adapted for service where compactness and strength are of prime importance. The pump cylinders are of the piston pattern and are fitted with substantial

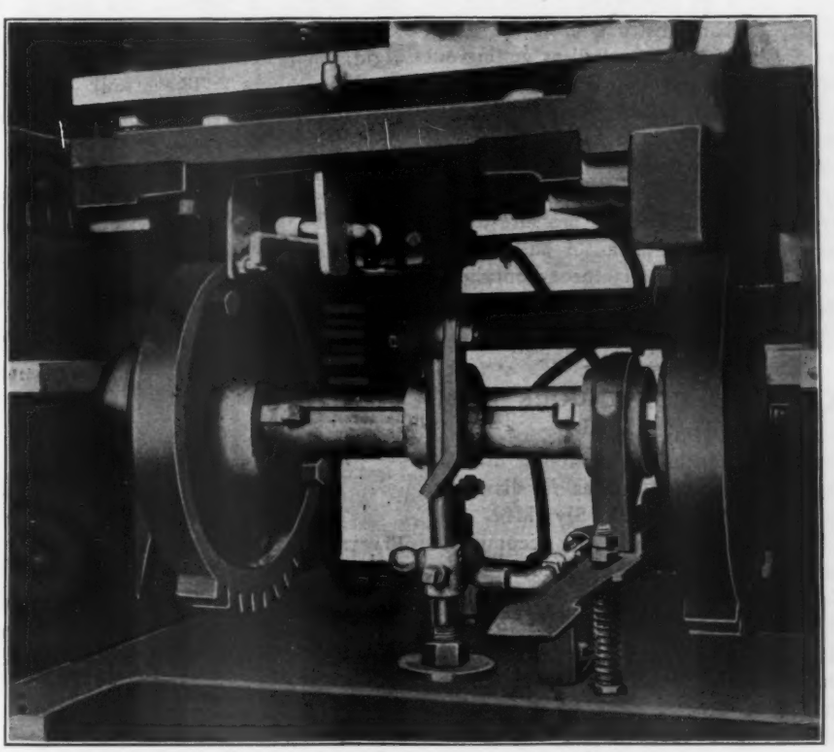
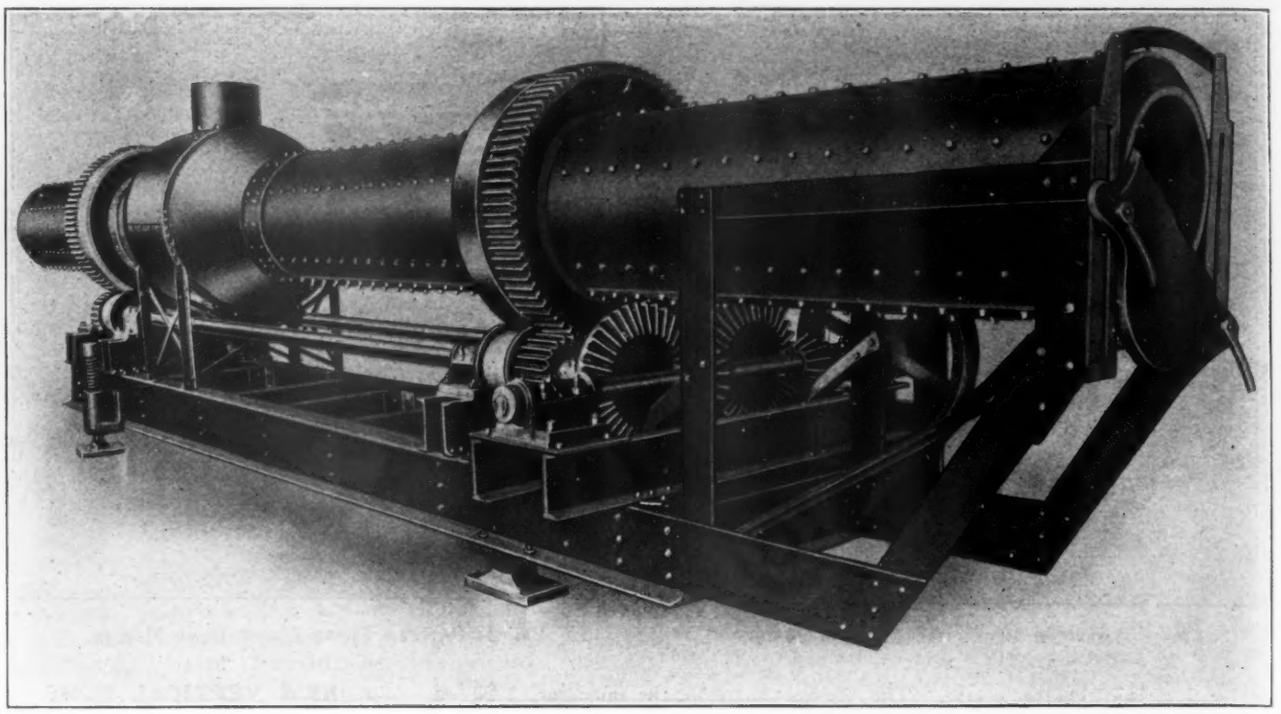


FIG. 3—FOOT LEVER AND PNEUMATIC FLASK PIN RAISING DEVICE, BERKSHIRE MOLDING MACHINE



LARGE CONTINUOUS TUMBLING MILL BUILT BY THE W. W. SLY MFG. CO.

brass linings. The pump pistons are very deep and are packed with fibrous packing suited for hot or cold water. The steam cylinders are of the regular duplex pattern and are similar in design to those which are used with the horizontal Blake-Knowles special duplex pumps. The cast iron cradle or center piece which ties the steam and water ends, is extremely rigid and is an improvement over the ordinary tie bar construction, as it permits no possibility of the cylinders getting out of alignment. The cylinders are fitted with brackets for bolting to a bulkhead or wall, although if preferred, a special base is fitted for placing the pump directly on the engine room floor. The pumps are suited for a working pressure of 200 pounds per square inch. A bulletin published by the manufacturer contains a table of sizes and dimensions of this new type of pump.

A LARGE CONTINUOUS TUMBLING MILL.

A large continuous tumbling mill, 36 feet long, and 28 inches in diameter, built by the W. W. Sly Mfg. Co., Cleveland, is shown in the accompanying illustration. The outlet of the barrel, provided with a door which can be adjusted at any angle to regulate the discharge of the castings, is shown at the right, some sections requiring a greater time to clean than others. The castings are charged at the opposite end of the barrel, and the desired incline is secured by two jacks which elevate the entire machine. The exhaust hood has been placed near the front end where the castings receive the first cleaning as it has been found that the largest amount of dust accumulates at this end. The barrel is of steel plate construction, 1 inch thick, and six staggered ribs are riveted to the inside of the barrel throughout its entire length to prevent the sliding of the castings. The frame is very rigid, being built of heavy structural steel members. The mill is belt driven, and in addition to the spur gears on the barrel, two welded tires are provided which rest on roller bearings.

ELECTRIC GLUE POT FOR PATTERNMAKERS

AN ELECTRIC GLUE POT.

The electric glue pot recently placed on the market by the General Electric Co., Schenectady, N. Y., embodies a new and interesting feature of design, which is found only in electric glue pots of this style, namely, the elimination of the water jacket.

The water jacket is a necessary feature of the ordinary glue pot, inasmuch as this water bath serves not only to distribute the heat evenly to all parts of the glue, but also prevents it from becoming overheated. While necessary, it is also the cause of so much trouble as to render the ordinary, and the earlier types of glue pots practically inoperative, when viewed from the standpoint of economy and satisfaction.

The elimination of the water jacket has been made possible by the adoption of a casting of pure aluminum which forms the glue pot proper. The high conductivity for heat together with proper design of heating unit and proportioning of radiating surface, combine to keep the glue at the proper temperature, although the maximum temperature of the exterior and bottom of the pot never exceeds 180 degrees Fahr.

The heating element is of the well known cartridge type, and possesses the characteristic features of simplicity, renewability and long life.

It has been found that a saving in electricity of as much as 50 per cent in the smaller sizes has resulted by the omission of the water jacket.

The practical efficiency of the General Electric glue pot renders it particularly valuable to carpenters, pat-

tern makers, etc. A two-quart glue pot is shown in the accompanying illustration.

LADWIG SKIM GATE.

To insure clean castings and prevent the slag from entering the molds while pouring, the skim gate shown in the accompanying illustrations has been devised. Fig. 1 shows the location and position of the gate in the flask. Two small outlet gates for taking iron from the pure metal chamber are represented by the small squares underneath the core. The receptacle to catch the dirt or scoria in the iron is shown in Fig. 2, and in Fig. 3 is shown the screen that the metal passes through before entering the mold. Fig. 4 shows the device adapted for snap flask work in position on top of the cope, and it can be used either in the center or corner of the flask, using the round gate. This gate can be adjusted for any depth of snap flask cope by sliding the block either upwards or downwards in the round gate. Plan and section of the core are shown in Fig. 5, and Fig. 6 shows the gate and core in position before the metal is poured. It is claimed that the cost of these gates is no greater than the labor cost of cutting them with molders' tools.

Shop license for the use of this gate can be had from Joseph Harrison, 318 Walker street, Milwaukee. Small gates

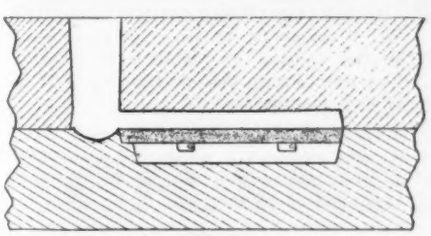


FIG. 1—LOCATION OF GATE IN FLASK

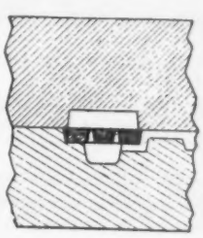


FIG. 2—DEVICE IN POSITION

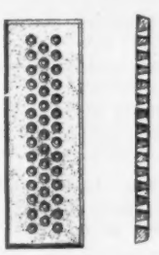


FIG. 3—THE SCREEN

furnished, will cast 175 pounds of metal, large gates 1,200 pounds and round gates 150 pounds. These gates can be made in any shop.

The Quincy, Manchester, Sargent Co., New York, announces that in order to devote more attention to its metal sawing machines, cranes and hoists, it has decided to discontinue the manufacture of pneumatic compression riveters. The entire line has been disposed of to the Hanna Engineering Works, Chicago. This concern will furnish repair parts for riveters now in use.

The Curtis & Co. Mfg. Co., St. Louis, manufacturer of pneumatic machinery and cranes, has opened an office in the Terminal building, New York, with A. L. Hoerman in charge.

The plant of the Stockham Mfg. Co., Piqua, O., manufacturer of foundry machinery, has been purchased by D. E. Hunter and Daniel W. Iddings, of Dayton, O. Mr. Hunter has been elected president.

The Reed Magnetic Separator described in the April issue of THE FOUNDRY is manufactured by R. Parsons & Co., Twenty-third and Hamilton streets, Philadelphia, Pa.

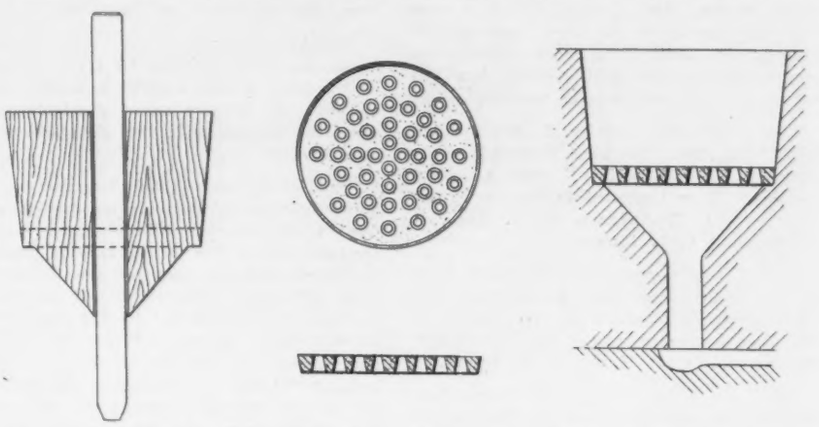


FIG. 4—SKIM GATE FOR SNAP FLASK WORK

FIGS. 5 AND 6—GATE AND CORE IN POSITION BEFORE THE METAL IS POURED

TRADE PUBLICATIONS.

MOLDING SANDS.—A booklet entitled "A Treatise on Molding Sand" has been issued by H. S. Vrooman, Eighteenth place and Sangamon street, Chicago. It contains much useful information regarding molding sands and gives an analysis of the various grades used daily in both gray iron and brass foundries.

ALLOYS.—A 60-page pamphlet describing electric furnace alloys has been issued by Geo. G. Blackwell Sons & Co., Ltd., Liverpool, England. Analyses of practically all of the alloys used in the iron and steel trades are given in this booklet, and their uses are carefully explained. As a reference work the catalog should prove invaluable to every foundryman, inasmuch as this work is probably the first compilation of the various alloys in use at the present time. In addition to the alloys, this concern also manufactures bauxite, magnesite, chrome fire brick, as well as chrome and manganese ore. The alloys for the brass founder manufactured by Geo. C. Blackwell Sons & Co. include silicon-copper, manganese copper, manganese zinc, magnesium copper, ferro-nickel, etc.

FERROINCLAVE.—The Brown Hoisting Machinery Co., Cleveland, in a 36-page catalog, describes Ferroinclave, which is the trade name of a corrugated sheet steel of special shape. It is used principally in the construction of fire-resisting roofing, siding, flooring, etc., for factory buildings, power plants and structures for industrial purposes. After it is secured in place it is coated on both sides with Portland cement mortar and becomes what is generally termed a reinforced concrete construction. The catalog is handsomely illustrated and methods of applying the steel are graphically shown.

CORE MACHINES.—The Diamond Clamp & Flask Co., Richmond, Ind., has issued a 20-page catalog, which is devoted to a description of the Gartside diamond automatic and plunger type core machines, as well as a full line of snap flasks, clamps and galvanized iron and steel slip boxes made by this concern. The automatic power core machine was described in the February issue of THE FOUNDRY. The line of snap flasks shown is very complete.

MELTING AND REFINING FURNACES.—A handsomely illustrated 80-page catalog, describing the Schwartz melting and refining furnace has been issued by the Hawley Down Draft Furnace Co., Chicago. These furnaces are designed for use by melters and refiners of brass, copper, bronze, aluminum, gray iron, malleable iron and steel. Crude and fuel oil or gas is used for fuel. The furnace is built in sizes ranging from 100 to 20,000 pounds per heat. The catalog contains many illustrations of furnace installations, not only in brass foundries, but iron and steel foundries as well. The information for brass foundrymen contained in this work should prove invaluable, inasmuch as it contains mixtures for various alloys used almost daily. The manufacture of steel in this furnace is also described in detail and many testimonial letters from satisfied users have been reproduced. The Hawley down draft system of smokeless combustion is also described and many illustrations of the application of this furnace are given.

CRANES.—A 44-page catalog describing electric traveling cranes from one to 100 tons capacity, hand-power traveling cranes from one to 50 tons capacity, ore and coal handling machinery, has been issued by the Cleveland Crane & Car Co., Wickliffe, near Cleveland. In preparing the catalog no effort was made to show all the different cranes built by this concern during the past 12 years, but rather to illustrate the various types, together with those improvements and advances that have recently been made in the construction of hoisting machinery. The catalog is handsomely illustrated with views of cranes in use in various industrial establishments.

GENERAL INDUSTRIAL NOTES

The Worcester Steel Foundry Co. has leased the plant at Millbury, Mass., to Eugene Edwards, Boston. Mr. Edwards already operates the steel foundry at the New England Steel Castings Co., Hyde Park, Mass. Both plants manufacture crucible steel castings, but they will be operated separately as heretofore.

The Waxahachie Foundry & Machine Co., Waxahachie, Tex., has been organized with a capital of $10,000, and will erect a jobbing foundry. Those interested in the new enterprise are: J. T. Andrews, W. A. Baird, E. W. Rice and E. L. Pierson.

Articles of incorporation have been taken out by the Bergstrom Stove Co., Neenah, Wis. This concern has operated a stove foundry at this place for many years. The incorporators are: George O., C. H. and J. W. Bergstrom.

The Guion Stove & Mfg. Co., Guion, Ark., has been incorporated with $10,000 capital, and will operate a stove foundry. The incorporators are: F. L. Staffell, J. H. Kitchens and J. M. Woods.

The Southern Foundry Co., Owensboro, Ky., has increased its capital stock from $40,000 to $85,000.

The Osborn Engineering Co., Cleveland, has awarded contracts for the foundry building of the Bay View Foundry Co., Sandusky, O., to the following concerns: General contract, including building, to G. W. Doerzbach & Bro.; cupola, crane, hoist and tumbling barrels, to the Northern Engineering Works, Detroit; generator, to the Westinghouse Electric Mfg. Co., Pittsburg; compressor, to the Bury Compressor Co., Erie, Pa.; blower, grinders and other machinery, to the Central Foundry & Supply Co., Columbus.

The Manitowoc (Wis.) Foundry & Machine Co. has been incorporated by Michael W. Glenn and Samuel G. Smith, with a capital of $30,000.

The receivership of the Westinghouse Machine Co., Pittsburg, was terminated on March 31. The property was turned back to the stockholders and the company will begin its fiscal year without debt, with cash in bank and with orders of sufficient volume to operate its plant at about 75 per cent.

The new plant of the Sheffield Stove Foundry Co., Chattanooga, Tenn., is rapidly nearing completion, and when operating in full 100 molders will be employed.

The Advance Radiator Co., Syracuse, Ind., is transferring the equipment of its Warsaw, Ind., plant to Syracuse.

The plant recently erected by the Sims-Kent Co., Salem street, Dover, N. J., has been purchased by the Lackawanna Steel Foundries and will be placed in operation shortly for the manufacture of gray iron, brass and bronze castings. The New York office of the company is at 74 Broadway. The officers of the new company are as follows: George Pierson, president; Henry E. Dixey, vice president; L. C. Hillard, second vice president and sales manager; J. H. Hurlbutt, treasurer; J. D. Brooks, secretary; and Jas. W. Kent, manager.

The Royal Foundry & Machine Co., Canton, O., has been organized with a capital stock of $15,000 by Paul Browsky, W. J. Putnam, G. P. Browsky, Geo. F. Adel and A. P. Mouer.

The Royersford Foundry & Machine Co., Royersford, Pa., has discontinued the manufacture of cast iron pulleys, and will dispose of the entire equipment for their manufacture including molding machines, etc.

The Yakima Iron Works, North Yakima, Wash., has completed plans for a large foundry. This concern already operates a machine shop, and with the foundry and new machinery ordered the investment in this plant will aggregate $20,000.

The United States Metal Recovery Co. has begun active work upon the construction of a plant at Frisco, near Ellwood City, Pa., for the treatment of rare metals, such as tungsten, vanadium, uranium, etc., for use among the steel industries. The plant will consist of the main building 85 feet by 150 feet, laboratories covering an area of 50 feet by 100 feet, power house 50 feet by 50 feet, and office building 40 feet by 75 feet. The buildings will be of concrete construction, particularly designed to meet the requirements of the operations which will be conducted in them. It is also planned to erect a number of substantial homes for the employes of the company, over 200 lots having been platted for this purpose. The work is now being advanced on the smaller buildings of the plant. The processes of manufacture which the company will use, are fully protected by patent, and it is expected that research work in an advanced manner not before attempted in this country, will be carried on. The officers of the United States Metal Recovery Co. are as follows: President, Robert McKnight; vice president, Jean De Backer; secretary and treasurer, Walter S. Butler, Pittsburg. The company's offices are in the Peoples Bank building, Pittsburg.

Kennedy's foundry and the Baltimore Malleable Iron & Steel Castings Co., Baltimore, have been incorporated to continue the foundry business which has been conducted for a number of years by the late Patrick Kennedy. The business will be conducted on the same lines as in the past.

The Litchfield Foundry & Machine Co., Litchfield, Ill., has purchased the entire equipment of the Aetna Foundry & Machine Co., Springfield, Ill., including drawings, patterns, etc., of their complete line of engines, sheaves, box car loaders, cages, fans and the entire mine equipment line of this concern.

New Construction.

The Coatesville Foundry & Machine Co., Coatesville, Pa., will erect a foundry and machine shop for the manufacture of boiler fronts, grate bars and miscellaneous castings. The foundry will be 114 x 208 feet and the pattern shop 40 x 60 feet. A pattern storage building will also be erected. The company is now in the market for several cranes of five and ten tons capacity each, and the question of molding machines is also being considered. The machine shop will be 114 x 208 feet. Considerable equipment for the foundry has been purchased from the Whiting Foundry Equipment Co., Harvey, Ill., including a 12-ton cupola.

The American Foundry & Construction Co., Pittsburg, has plans under construction for extensive improvements to its foundry, which will more than double the output.

The Nashville Foundry Co., Nashville, Tenn., recently organized, is proceeding with the erection of its buildings, including a foundry.

The American Car & Foundry Co., St. Louis, will erect a large addition to its plant at Binghampton, Tenn., near Memphis, including a large wheel foundry. The expenditures will approximate $200,000.

The Balderson Iron Co., Beloit, Wis., will erect a new foundry and will shortly be in the market for considerable equipment.

The Union Steel Casting Co., Pittsburg, has begun the erection of an extension, 45 x 180 feet, to its finishing shop. A new pattern and pattern storage building has recently been completed, practically doubling the capacity of this department.

The Gifford-Wood Co., Hudson, N. Y., manufacturer of ice tools, will erect a foundry 80 x 100 feet and a pattern shop 100 x 110 feet. The company is now in the market for the equipment for these plants.

James B. Clow & Sons, Chicago, will erect a large pipe foundry, including finishing departments and machine shops, at Coshocton, O., and will ultimately abandon its present plant at Newcomerstown, O. A site of 50 acres has been secured at Coshocton for the new plant, which will have about three times the capacity of the present works. The buildings include two large foundries, one 125 x 700 feet and the other 100 x 400 feet. The melting equipment will consist of six cupolas. The other buildings that will be erected include two large machine shops, pattern shop, storage warehouse and a commodious office building. The buildings will be built throughout of reinforced concrete. It is estimated that $1,000,000 will be expended in the erection and equipment of the plant.

The Keystone Steel Castings Co., Avonmore, Pa., is increasing its steel producing capacity by the addition of an open-hearth furnace. This will increase the output to about 25 tons of steel castings daily.

The John F. Byers Co., Ravenna, O., has recently completed a number of extensions to its plant, including a foundry 75 x 100 feet with a 6-ton cupola.

Brass Foundries.

The Comstock Brass Co., Cleveland, recently incorporated with $10,000 capital, is erecting a brass foundry at 2539 East Seventy-ninth street. The foundry will be 40 x 115 feet. For the present the company will engage in the jobbing brass foundry business. The foundry equipment has been purchased from the J. D. Smith Foundry Supply Co., Cleveland. The officers are: C. W. Comstock, president and treasurer; J. H. Shafner, secretary; and M. J. Arth, superintendent.

The Challenge Brass Co. is the firm name of the new concern that will operate the brass foundry formerly conducted by the Nettleton & Kelsey Co., New Haven, Conn. The new owners are: E. F. Millett and W. H. Burt, who were formerly foremen in the employ of the Waterbury Mfg. Co., Waterbury, Conn. The company will manufacture brass, bronze and aluminum castings, as well as babbitt and tight metals.

To provide larger funds to handle its increased volume of business the Standard Brass Works, Detroit, has increased its capital from $5,000 to $30,000.

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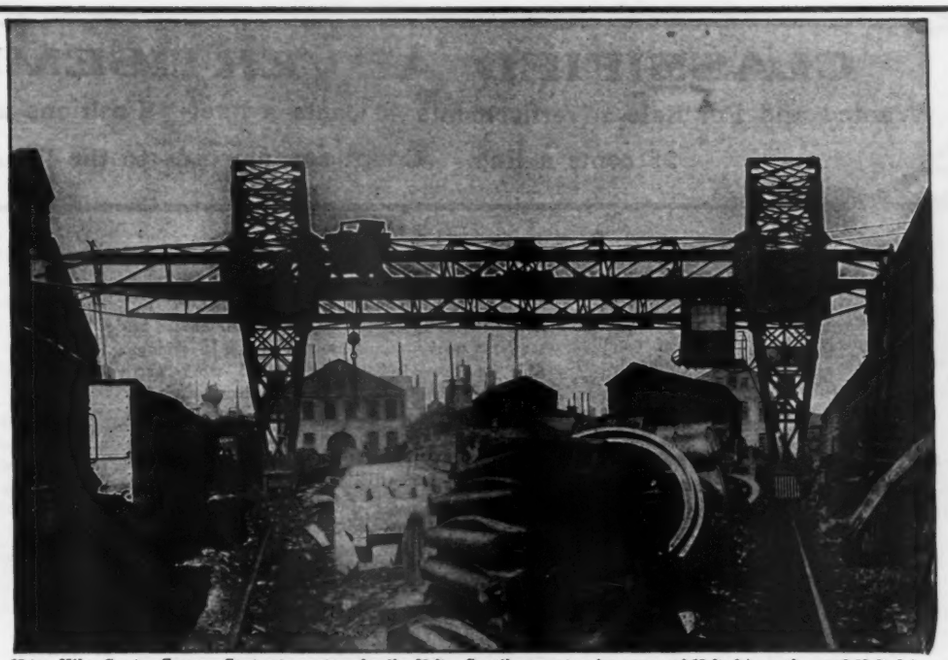

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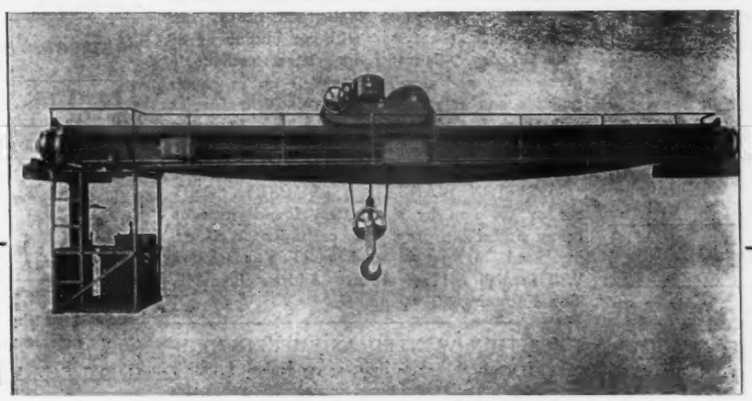

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POSITION WANTED BY A1 FOUNDRYman who will be at liberty shortly. Well versed in modern foundry practice and gray iron jobbing. Boiler and radiator work preferred. Correspondence solicited. Address Box 759, THE FOUNDRY, Cleveland, O.

SITUATION WANTED BY AN A-1 foundry foreman. Capable of handling men. Practical molder and core maker. Up-to-date on molding machines and cupola work. Best of references furnished. Am open for engagement. Address Box 788, THE FOUNDRY, Cleveland, O.

POSITION WANTED BY FOUNDRY foreman, who has had a wide experience in gray iron and steel. No objection to open or non-union shop. Can furnish the best of references as to character and ability. Address Box 774, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOREMAN OR assistant foundry foreman; 32 years old, 16 years in general jobbing foundry, four years of this foreman. Can furnish good references on light and heavy work, green or dry sand. Address Box 780, THE FOUNDRY, Cleveland, O.

POSITIONS WANTED, MISCELLANEOUS

POSITION WANTED BY EXPERT MALleable iron annealer. Address Box 790, THE FOUNDRY, Cleveland, O.

SITUATION WANTED BY YOUNG MAN with five years' experience in foundry. Will be graduated in mechanical engineering in June and open for position. Address Box 779, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOREMAN OR bench man by wood patternmaker with 15 years' experience. Will furnish reference. Address Box 784, THE FOUNDRY, Cleveland, O.

BUSINESS OPPORTUNITIES

INVENTORS ATTENTION: MERITOrious patented foundry machinery manufactured on royalty basis. Long experience and unexcelled facilities for reaching foundry trade. Whiting Foundry Equipment Company, Harvey (Chicago Suburb), Ill.

NEW CONCRETE AND BRICK ONEstory factory building and 30-acre site ready for occupying suitable for foundry, hardware, engine or machine works, are offered for 65 cents on the dollar. Ideal location on Lake Shore Railway and Lake Erie at Port Clinton, Ohio. For further information address Wm. B. Knight, Port Clinton, Ohio.

WILL BUY MALLEABLE IRON FOUNdry, fully equipped and running. Give full particulars regarding present output, full capacity, etc. Address Box 786, THE FOUNDRY, Cleveland, O.

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BLOWER BARGAINS.
Roots Second-Hand Blowers, bought, sold, or exchanged for new ones. Address,
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ONE LADLE FOR SALE, CAPACITY 7,000 pounds; worm geared. Has been used, but is in good condition. Will sell cheap. Morris Machine Works, Baldwinsville, N. Y.

MOLDING MACHINES FOR SALE

TWO ARCADE MOLDING MACHINES for sale at a sacrifice. Acme Steel & Malleable Iron Works, Buffalo, N. Y.

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FLUOR SPAR.—EVERY GRADE. QUOtations delivered anywhere. Cheapest suppliers. Address GEO. G. BLACKWELL SONS & CO., Ltd., Liverpool, Eng., or Agents, Penna. Salt Mfg. Co., Pittsburg, Pa.

FLUOR SPAR—BY THE BARREL, TON or car lots. Address American Fluor Spar Co., Paducah, Ky.

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SECOND HAND GOODS FOR SALE.
1 Sellers's Centrifugal Sand Mixer.
1 36 x 48 Tumbling Barrel C. I.
1 Portable Millet Core Oven.
1 Tripod Pneumatic Sifter.
3 McKenna Molding Machines and Flasks.
1 1200-lb. Cap. Sulky Ladle.
27 Brass Foundry Furnaces, assorted.
1 54-in. Crandall Cupola.
1 No. 2 4 & 5 Baker blower.
1 No. 5 "B" Green blower.
1 No. ½ Roots blower.
15 16 x 16 x 3 in. Cope and 2 in. Drag Barnet Iron Flasks.
J. W. Paxson Co., Philadelphia, Pa.

FOUNDRY EQUIPMENT WANTED

SECOND-HAND FOUNDRY EQUIPMENT wanted, including Cupolas, Ladles, Tumbling Barrels, etc. Quote price and state condition. Address Box 885, THE FOUNDRY, Cleveland, Ohio.

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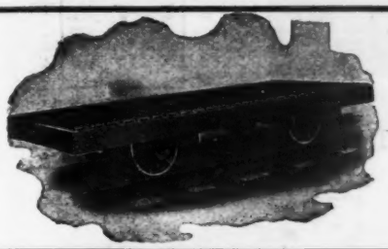
FOUNDRY SPECIALIST. IF YOU HAVE trouble with your iron call on us. We have a specialist we send out who we know is fully capable of adjusting your difficulties and in a very short time. It will pay you well to consult with us when in trouble. A. Buch's Sons Co., Elizabethtown, Pa.



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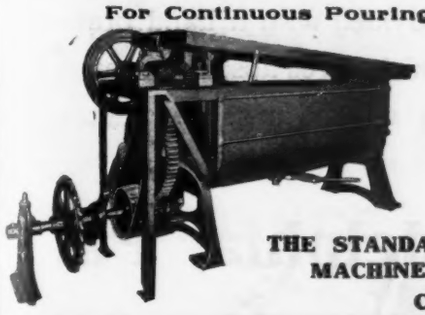

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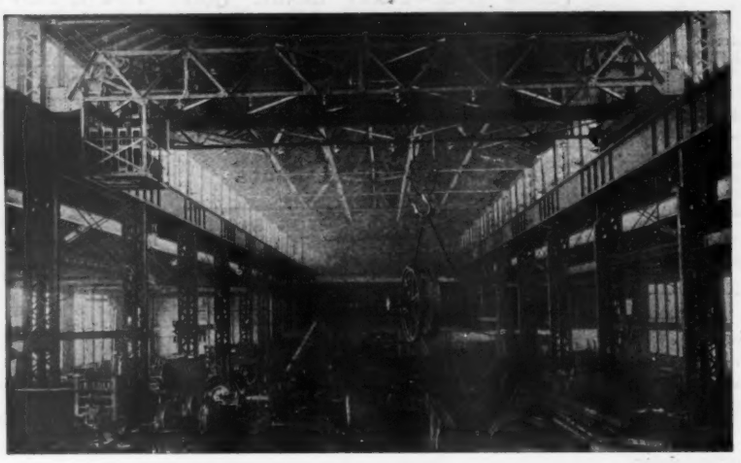

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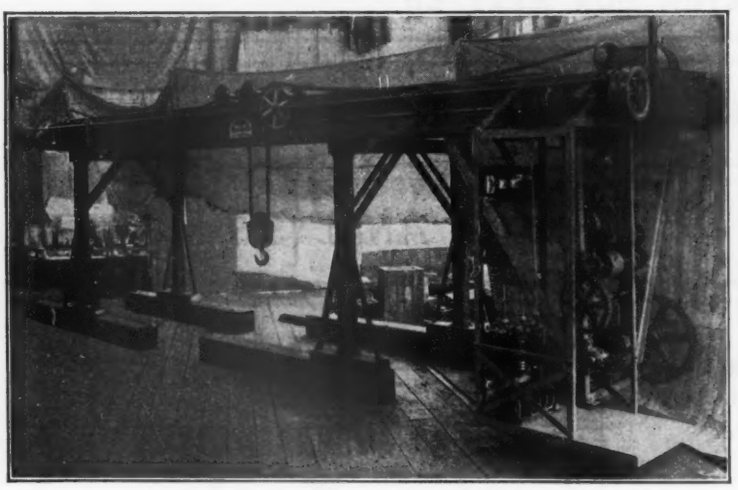

WHERE the head room is limited and the ladle of hot metal comes close up to the bridge, it is desirable to keep the hoist and motor away from the heat. In addition to the usual automatic electric and mechanical brakes the hoist is provided with a hand brake which gives absolute control of the lifting speed from full speed with a full load, to a few inches a minute for drawing patterns.

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